# NUTRITION AND DIET

## IN HEALTH AND DISEASE

JAMES S. McLESTER, M.D.
*Professor of Medicine Emeritus, University of Alabama*

WILLIAM J. DARBY, M.D., Ph.D.
*Professor of Biochemistry and Director of the Division of Nutrition, Vanderbilt University*

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# *Preface*

This the Sixth Edition of this book is marked by the appearance of a collaborator on the title page The division of the primary responsibility for this revision has been such that each of us was able to devote himself to approximately half of the book—the senior author to the second portion the junior author to the first half We have not however imposed restrictions on our assignments and have freely exchanged advice and assistance This pleasant association has made possible a more searching revision of the text which has been completely reset by the publisher

Our aim has been to provide the reader with a modernized version of the subject matter formerly covered by this book The general organization of the earlier editions has been retained but chapters have been unsparingly rewritten

The sections on the vitamins have been completely reconsidered in keeping with the recognized importance of the newer factors especially folic acid vitamin $B_{12}$ and vitamin $B_6$ in human nutrition An especial effort has been made to incorporate appraisals of useful biochemical diagnostic measures and to evaluate dietary requirements The mass of information which has accumulated regarding the requirements of man for amino acids the amino acid vitamin interrelationships and the amino acid composition of the diet has been incorporated The medically significant developments in the field of the trace elements and other minerals are developed The section on deficiency diseases has been brought up to date and a discussion of Kwashiorkor added

Such topics as the low sodium regimen and the rice diet for the treatment of hypertension the management of nutritional anemias including pernicious anemia and the deficiency diseases have been revised in keeping with the great changes which have taken place in our understanding of these disorders within the past few years The new system of dietary equivalents for the planning of diabetic diets has been added and alterations made in many of the dietary plans in keeping with the growing tendency to plan therapeutic diets as simply as possible There has been retained however those older diets and menus the value of which has been proved by time

Each table has been reconsidered and numerous replacements have been made in order to present current information in the most usable form Among the revisions may be mentioned the inclusion of the newest of the extensive compilations of food composition the incorporation of tables of cholesterol values of foods of sodium and potassium content of foods and waters and a list of available low sodium processed

foods of new estimates of caloric standards for feeding of amino acid composition of the Canadian Dietary Allowances of tables of ideal weight for adults and revised tables of recommended quantities of foods for low and moderate cost diets

Throughout selective revision of the bibliography has been made to retain, significant classical references and still useful reviews to add modern reliable reviews and to document most recent developments

The authors are especially grateful to Dr P C Jeans Professor of Pediatrics at the University of Iowa to Dr Robert S Goodhart Director of the National Vitamin Foundation and to Dr Charles C Lund Assistant Clinical Professor of Surgery Harvard Medical School for revising their valued chapters on Infant Feeding Nutrition in Industry and Nutrition of the Surgical Patient respectively We are deeply indebted to Miss Bernice Hopkins Director of the Department of Dietetics Vanderbilt University Hospital for her invaluable assistance in revising many of the dietaries To our numerous friends who have permitted us to reproduce data from their publications we are most grateful Finally we wish to acknowledge our indebtedness to those who have worked in the composition of the book especially our loyal and efficient assistants Miss Mary Louise Still and Miss Blanche Frazier and the patient publisher the W B Saunders Company

JAMES S MCLESTER
WILLIAM J DARBY

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# NUTRITION AND DIET IN HEALTH AND DISEASE

# *Introduction*

Nutrition is the sum of those processes by which the living organism receives and utilizes the materials necessary for the maintenance of life This includes growth the repair of worn out structures and the liberation of energy The energy thus set free appears in the form of heat mechanical work and electric currents and perhaps also in ways yet unrecognized

Food has been defined as a palatable mixture of foodstuffs A foodstuff is a material which is capable of being added to the body substance or which when absorbed into the blood stream will prevent or reduce the wasting of a necessary constituent of the organism * For the animal organism these nutritive substances are water inorganic salts the major organic foodstuffs and certain other substances of various chemical structure which are grouped together as vitamins The union of oxygen with the organic foodstuffs or their cleavage products maintains life and warmth in the cells

Water is the most urgently needed of these substances which need can be measured by the exceeding promptness with which symptoms of deprivation appear and their extreme gravity The inorganic constituents of the food are also essential though their deprivation is not so immediately felt

The well known organic foodstuffs carbohydrates proteins and fats contain stored energy which may be liberated in the body Here as elsewhere the law of the conservation of energy is valid when these substances are broken down through oxidation to simpler chemical bodies they give to the animal organism the same amount of energy as would be liberated by similar conversion in the test tube The energy contained in any foodstuff may be determined accurately by measurement of the heat which it yields on combustion in a calorimeter It is expressed in units of heat known as Calories a Calory being the amount of heat necessary to raise the temperature of 1 kilogram of pure water from 15° to 16° C

The utilizable portion of this stored energy varies somewhat according to its source for an average mixed diet Rubner adopted the following standard values 1 gm of carbohydrate yields 4 1 Calories 1 gm of protein 4 1 Calories 1 gm of fat 9 3 Calories The Atwater factors which take into account digestion losses have been most widely used in America These values are 1 gm of carbohydrate yields 4 Calories 1 gm of protein 4 Calories 1 gm of fat 9 Calories †

* Definition by Graham Lusk

† Maynard L A The Atwater System of Calculating the Caloric Value of Diets J Nutrition *28* 443 1944

Each of the three major foodstuffs plays its own part in the processes of nutrition *Carbohydrates* form the most important source of energy for heat and mechanical work they are the chief as well as the most economical and readily available source of muscle energy *Fats* on oxidation liberate heat and thus contribute to the maintenance of body warmth they also furnish energy for muscular work *Proteins* serve to build and maintain the great variety of body tissues including numerous catalysts within the tissues In addition, they may, by interconversion to carbohydrate and fat, be used as sources of fuel for the body The three may be substituted for one another to a certain extent For proteins however, the limits of substitution are particularly well defined and indicate a point beyond which safe reduction or substitution is impossible the presence in the diet of a small amount of nitrogenous food 'the wear and tear quota is essential A minimum of fat also seems necessary

The group of essential organic food factors known as vitamins are sometimes classed as 'accessory substances They are required in the dietary in quantities measurable in micrograms (0 000001 gm) to milli grams (0 001 gm) The vitamins embrace a heterogenous group of chemical substances the function of which appears to be related to their presence as essential portions of one or another metabolic enzyme

The necessary inorganic substances must be provided by the diet These elements may serve as quantitatively important structural materials as do calcium and phosphorus or as quantitatively minute but essential por tions of enzyme systems or hormones, as is the case with copper, iron zinc iodine and the like

In the following chapters the manner in which these several foodstuffs are utilized and the influences exerted by each will be discussed Then will follow an analysis of man s nutritive needs in health and in sickness with a final consideration of the practical arrangement of the diet in disease

# PART I

# NUTRITION IN HEALTH

THE NEED FOR FOOD AND ITS UTILIZATION

# 1

## Utilization of Food

### DIGESTION

The animal requires food for energy, growth and the repair of worn out structures The first step in the utilization of food is digestion, the object of which is to render the nutritive substances absorbable A few sub stances do not require digestion and are absorbed as such, but all other foodstuffs must undergo profound changes before they are utilizable These changes are both physical and chemical in nature

**The Mouth.** In the mouth the food is subjected to a twofold process: First, while being constantly moistened and softened by the saliva, it undergoes maceration through the grinding action of the teeth Then, after being buffered and reduced to the proper physical state, it is sub jected to the influence of the enzyme ptyalin, with the result that maltose is split off from starch To make the action of this enzyme possible, however, the food must be sufficiently cooked so that the starch granules are disrupted, for ptyalin will not penetrate the cellulose capsule The food remains in the mouth such a short time that only a small portion is acted upon, and further digestion must therefore take place in the stomach and intestines

The digestive functions of the mouth extend further The saliva brings into solution certain substances agreeable to the taste, and these, acting on appropriate nerve endings, serve the important purpose of stimulating the appetite and of starting the flow of the other digestive juices The mouth also helps in the preservation of water balance, for the drying of the oral mucous membrane arouses the sensation of thirst and thus serves as a protective mechanism against dehydration

**The Stomach** The digestive functions of the stomach, like those of the mouth, are both mechanical and chemical Here, too, the mechanical is the more important, for it is the chief duty of this organ to break up the food and to reduce it to a semisolid consistency such as will allow the digestive ferments easy access As the food enters the stomach, the upper half, which is in a weak state of tonic contraction, relaxes and permits the accumulation of a somewhat stratified food mass That which entered first is pushed toward the periphery, and that which was swal lowed last remains in the center, with the result that for a half hour or

sham feeding of dogs is potent also in man Carlson s subject whose esophagus had been completely closed by a stricture showed a marked rise in gastric secretion when permitted to chew the foods he liked such as desserts and fruits It was noted in the latter instance however, that gastric secretion began to decline as soon as stimulation of the taste buds ceased From such observations it is obvious that for good digestion the food should be agreeably prepared and should be presented in a pleasing way

The factors originating in the stomach which stimulate gastric secretion include both *mechanical* and chemical stimuli Although Pavlov doubted the presence of the former, Toy and Farrell have shown that after a latent period such influences do to a limited extent have a stimulating effect *Chemical stimuli* have a much more pronounced effect the most powerful of these being exerted by meat This effect of meat is attributed to its extractives for not only do meat juices and broths evoke a copious secretion of gastric juice but pure proteoses and peptones do also Many theories have been offered to explain the mechanism of this chemical stimulus but the generally accepted explanation[5] is that a hormone (gastrin), possibly identical with histamine is formed by action of the food upon the pyloric mucosa and that this after absorption into the blood is carried to the fundic glands to excite their activity

There is also an *intestinal* phase of gastric secretion for it has been shown that the placing of various substances such as peptones and other meat extracts directly in contact with the duodenal mucosa will excite an increased flow of gastric juice An opposite effect produced by a humoral mechanism is induced by ingested fats after they reach the small intestine Psychic influences also have a retarding effect for anger and other emotions as well as disgusting sights and odors will inhibit the flow of gastric juice

The stomach empties itself of an ordinary mixed meal in three to four and a half hours Fluids and semifluids flowing along the magenstrasse pass through almost immediately carbohydrates more slowly meats still more slowly and fats slowest of all Any factor psychic or chemical which stimulates or inhibits the peristaltic waves will correspondingly hasten or retard the emptying of the stomach The hyperactivity brought about by emotional states persists despite the ingestion of fat The inhibitory action of fat however was found to be accentuated during fear[2]

**The Small Intestine** In the small intestine the importance of the enzymic or chemical aspect of digestion predominates over the mechanical one The muscular movements of the small intestine can be characterized as peristaltic segmenting and pendular The peristaltic waves are of two kinds—sluggish slowly moving waves traveling at the rate of 1 or 2 cm per minute and rush waves which travel shorter or greater distances at the rate of 10 cm or more per second carrying everything with them The segmenting movements are rhythmic annular contractions which repeatedly divide and redivide the food mass The pendular movements are vaguely defined annular contractions which with a frequency of ten to twenty per minute travel for short distances up and down a

loop of intestine. These movements accomplish a thorough kneading and mixing of the intestinal contents and thus facilitate digestion and absorption.

Chemical digestion in the small intestine is accomplished through the contributions to this tract of the pancreas, the intestinal glands and the liver. The pancreatic enzymes[9] may be considered the most important. The best understood of these are (1) *trypsin,* which is secreted as trypsinogen, activated in the intestine by enterokinase, and which is strongly proteolytic; (2) *chymotrypsin,* also secreted as a precursor, and the activated enzyme is a major proteolytic ferment; (3) *pancreatic amylase,* which splits starch, even raw starch, to dextrins and maltose; (4) *lipase,* the most important fat-splitting enzyme in the gastrointestinal tract, which hydrolyzes fats to glycerol and fatty acids, probably through the stages of mono- and di-glycerides. These split products of fats are important emulsifying agents within the gastrointestinal tract.[6]

The secretion of pancreatic juice is stimulated by a hormone called *secretin.*[5] This is liberated by the intestinal mucosa when it comes in contact with the acid chyme of the stomach and is absorbed into the blood stream, to be then carried to the pancreatic cells. The chief effect of secretin, however, appears to be the calling forth of the alkaline juice, while the stimulation of enzyme secretion is controlled by other mechanisms such as a fraction of crude secretin (pancreozymin) and neurogenic regulation.

The intestinal juice, or succus entericus, is secreted by the glands of the intestinal mucosa. It is alkaline in reaction and, in addition to contributing to the activation of trypsin, contains the following types of enzymes: proteolytic *peptidases,* which split the polypeptides to amino acids; *phosphatases,* which hydrolyze nucleotides, glycerophosphates and hexosephosphates to inorganic phosphate and an organic portion; *carbohydrases,* which split sucrose, maltose or lactose into the constituent monosaccharides, glucose, fructose and galactose; and *lipase,* which is of relatively little importance. The secretion of succus entericus is promoted by mechanical stimulation of the bowel wall and possibly also through the influence of a hormone called enterocrinin.[5]

The bile contains chiefly bile salts, bile pigments, cholesterol and lecithin. The bile salts, sodium glycocholate and taurocholate, are almost completely resorbed from the intestine and are returned by the portal circulation to the liver, whence they are again excreted.[7] *Bilirubin* is formed in the liver from the hemoglobin brought to it, but the liver is not its only source; it is also formed by the elements of the reticulo-endothelial system elsewhere. The bile contains practically no digestive ferments, but it is essential to the proper digestion of fat by the enzymes of the pancreas and intestinal glands. The bile salts have the property of lowering surface tension and thus of producing a finer emulsion, which results in turn in the exposure to the pancreatic lipase of an enormously increased surface area of fat globules. A similar though indirect effect is accomplished by these salts when they facilitate the solution of the fatty acids.

The normal absorption of lipids is dependent upon the presence in the gut of both lipase and bile. The emulsifying action of both the bile salts and of partially hydrolyzed fats (mono- and diglycerides) is important.[6] The concept of the exact mechanism of absorption of fat is confused but recent studies of Bloom et al.[5] reconfirm the older concept of the quantitative importance of the lymphatics in the absorption of lipids Regardless of whether the lipid is ingested as fat or fatty acid the major transport canal of fat or fatty acids seems to be the intestinal lymphatics and the thoracic duct. The absorption of lipid soluble factors such as the fat soluble vitamins A K D E and carotenes is dependent upon the intact system for the absorption of fat

**The Formation of Feces** It is a popular belief that the feces consist of unabsorbed food residues This is far from true they consist in large part of intestinal secretions and excretions of cellular material from the intestinal walls of bacteria and (except in diarrhea) only in small part of food residues The nitrogen content of the feces is relatively independent of the diet but is increased when the digestion of protein is impaired by such conditions as pancreatic disease Evidently in health the fecal nitrogen comes largely from the secretions which are poured into the intestines Mosenthal in his studies of the succus entericus of isolated intestinal loops concluded that its nitrogen content is from 300 to 400 per cent of the nitrogen content of the feces and that obviously a large part of this nitrogen is reabsorbed Likewise the fecal fat is not the identical fat that was eaten

Concentrated foods such as cottage cheese eggs and meat are completely digested and are absorbed almost in toto therefore they leave little residue The experiments of Hosoi have revealed the surprising fact that both milk and bread leave large residues (see Low Residue Diets p 140) When large amounts of fruits and vegetables are eaten there remains a rather large residue of undigestible cellulose which undergoes fermentation and through the absorption of water gives to the bowel content the proper bulk and consistency

The physical characteristics as well as the composition of the feces are determined in part by the kind of diet but it is a mistake to assume that the residues from different meals can be sharply divided and recognized in the feces Alvarez and Freedlander found that minute glass beads given with the food did not pass through the intestinal tract at the same rate of speed some went through rapidly and others required a week or more to pass Evidently any given specimen of feces may contain residues of food eaten a week or more previously The significance of this for studies of metabolic balance is obvious The average person excretes from 100 to 150 gm of feces which amount is sometimes doubled or still further increased by the ingestion of large quantities of vegetables and fruits

**Significance of the Intestinal Flora** An appreciation of the probable importance of the intestinal flora in nutrition has evolved during the last decade Experimental animals treated with sulfonamides or other agents which greatly alter the character of the intestinal flora may exhibit a

variety of vitamin deficiency syndromes, such as hypoprothrombinemia of vitamin K deficiency, leukopenia of folic acid lack, pantothenic acid deficiency, avitaminosis E and other syndromes[10]

In the human newborn it seems that hypoprothrombinemia disappears with the establishment of the intestinal flora This observation is interpreted as indicating that the bacteria synthesize vitamin K, which, in turn, is absorbed and relieves the hypoprothrombinemia[11] Balance studies on man support the hypothesis that the synthesis of B vitamins may occur within the gastrointestinal tract[12] Live yeasts in the gastrointestinal tract may "absorb" or render unavailable some vitamins, particularly of the B complex.[13] One cannot yet predict the exact nutritional importance of the intestinal flora in man, but the subject is under active investigation by many workers

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# 2

## Utilization of Food (Continued)

### METABOLISM

#### Basal Metabolism

Man expends the energy obtained from his food in the functional activities of various organs, mechanical work, regulation of body temperature and in the process of growth and repair. The chemical changes incident to all this are grouped together under the term "metabolism." These reactions, although manifold, are in the last analysis the result of oxidation, and their sum is therefore expressed with a high degree of accuracy by the amounts of oxygen consumed and of carbon dioxide liberated. This energy exchange is commonly expressed in heat units, Calories, produced per hour or per twenty four hours. It is directly proportionate to the surface area of the body or, more correctly stated, to some other, more fundamental factor, such perhaps as the active protoplasmic mass, which in itself is proportionate to the surface area.

When a person is awake, at complete rest, in an environment at a comfortable temperature, and in the postabsorptive state, the production of energy is relatively constant and low. This level of energy production is referred to as basal metabolism. It is remarkably standard under standard conditions, but like other biologic phenomena, it exhibits measurable variability. Basal metabolism is not of necessity the lowest obtainable metabolic level. Lower levels are observable during sleep or caloric undernutrition. Because of usage, however, and with a clear understanding of its limitations, "basal metabolism" remains the accepted term.

For the same species under identical conditions the basal metabolic rate, with rare exceptions, shows a remarkable constancy. Between the ages of twenty and fifty, for example, the mean rate per square meter of body surface per hour has been found to vary between 41.4 and 37.4 Calories; for women the level is slightly lower, 36.2 to 33.9 Calories.[1] The variability about this mean is essentially normal. Accordingly, an expected proportion of healthy subjects will deviate from the normal standard. From the study of the distribution of normal persons, Boothby, Berkson and Dunn[1] have constructed a nomogram which provides an estimate of the probability that an observed value may occur within a

Table 1 *Analysis of the Oxidation of Mixtures of* Carbohydrate and Fat

| R Q | Percentage of Total Oxygen Consumed by | | Percentage of Total Heat Produced by | | Calories per Liter $O_2$ | |
|---|---|---|---|---|---|---|
| | Carbo-hydrate (1) | Fat (2) | Carbo-hydrate (3) | Fat (4) | Number (5) | Logarithm (6) |
| 0.707 | 0 | 100.0 | 0 | 100.0 | 4.686 | 0.67080 |
| 0.71 | 1.02 | 99.0 | 1.10 | 98.9 | 4.690 | 0.67114 |
| 0.72 | 4.44 | 95.6 | 4.76 | 95.2 | 4.702 | 0.67228 |
| 0.73 | 7.85 | 92.2 | 8.40 | 91.6 | 4.714 | 0.67342 |
| 0.74 | 11.3 | 88.7 | 12.0 | 88.0 | 4.727 | 0.67456 |
| 0.75 | 14.7 | 85.3 | 15.6 | 84.4 | 4.739 | 0.67569 |
| 0.76 | 18.1 | 81.9 | 19.2 | 80.8 | 4.751 | 0.67682 |
| 0.77 | 21.5 | 78.5 | 22.8 | 77.2 | 4.764 | 0.67794 |
| 0.78 | 24.9 | 75.1 | 26.3 | 73.7 | 4.776 | 0.67906 |
| 0.79 | 28.3 | 71.7 | 29.9 | 70.1 | 4.788 | 0.68018 |
| 0.80 | 31.7 | 68.3 | 33.4 | 66.6 | 4.801 | 0.68129 |
| 0.81 | 35.2 | 64.8 | 36.9 | 63.1 | 4.813 | 0.68241 |
| 0.82 | 38.6 | 61.4 | 40.3 | 59.7 | 4.825 | 0.68352 |
| 0.83 | 42.0 | 58.0 | 43.8 | 56.2 | 4.838 | 0.68463 |
| 0.84 | 45.4 | 54.6 | 47.2 | 52.8 | 4.850 | 0.68573 |
| 0.85 | 48.8 | 51.2 | 50.7 | 49.3 | 4.862 | 0.68683 |
| 0.86 | 52.2 | 47.8 | 54.1 | 45.9 | 4.875 | 0.68793 |
| 0.87 | 55.6 | 44.4 | 57.5 | 42.5 | 4.887 | 0.68903 |
| 0.88 | 59.0 | 41.0 | 60.8 | 39.2 | 4.899 | 0.69012 |
| 0.89 | 62.5 | 37.5 | 64.2 | 35.8 | 4.911 | 0.69121 |
| 0.90 | 65.9 | 34.1 | 67.5 | 32.5 | 4.924 | 0.69230 |
| 0.91 | 69.3 | 30.7 | 70.8 | 29.2 | 4.936 | 0.69339 |
| 0.92 | 72.7 | 27.3 | 74.1 | 25.9 | 4.948 | 0.69447 |
| 0.93 | 76.1 | 23.9 | 77.4 | 22.6 | 4.961 | 0.69555 |
| 0.94 | 79.5 | 20.5 | 80.7 | 19.3 | 4.973 | 0.69663 |
| 0.95 | 82.9 | 17.1 | 84.0 | 16.0 | 4.985 | 0.69770 |
| 0.96 | 86.3 | 13.7 | 87.2 | 12.8 | 4.998 | 0.69877 |
| 0.97 | 89.8 | 10.2 | 90.4 | 9.58 | 5.010 | 0.69984 |
| 0.98 | 93.2 | 6.83 | 93.6 | 6.37 | 5.022 | 0.70091 |
| 0.99 | 96.6 | 3.41 | 96.8 | 3.18 | 5.035 | 0.70197 |
| 1.00 | 100.0 | 0 | 100.0 | 0 | 5.047 | 0.70303 |

Formula for Column $(R.Q. = R)$

(1) Per cent $= 100\dfrac{R-0.707}{0.293}$

(2) Per cent $= 100\dfrac{1.00-R}{0.293}$

(3) Per cent $= \dfrac{504.7(R-0.707)}{504.7(R-0.707)+4.686(1.00-R)}$

(4) Per cent $= \dfrac{468.6(1.00-R)}{5.047(R-0.707)+4.686(1.00-R)}$

(5) Calories $= 4.686 + \dfrac{R-0.707}{0.293} \times 0.361$

(6) Logarithm = log of Column 5

(From Lusk G Animal Calorimetry Analysis of Oxidation Mixtures of Carbohydrate and Fat. J Biol Chem., Vol 59)

## The Respiratory Quotient

Precise analysis of metabolism during a given period demands a knowledge of (1) the volume of oxygen consumed, (2) the volume of carbon dioxide eliminated, and (3) the quantity of nitrogen excreted in the urine The quantitative relation which the first two of these bear to each other, $\frac{\text{volume of } CO_2 \text{ produced}}{\text{volume of } O_2 \text{ consumed}}$, constitutes the respiratory quotient The amount of each of these gases involved is determined by the kind of food stuff metabolized This quotient therefore, when considered in connection with the amount of nitrogen excreted in the urine, will tell with a high degree of accuracy the quantity of each foodstuff, carbohydrate, protein and fat, destroyed Witness the combustion of carbohydrate This foodstuff contains hydrogen and oxygen in the exact proportion to form water, two atoms of the former to one of the latter In considering the net process of oxidation the oxygen in the carbohydrate suffices to combine with the hydrogen Thus additional oxygen must be supplied only to the extent to combine with the carbon of the molecule to form carbon dioxide In such a reaction one molecule of oxygen produces one molecule of carbon dioxide, and because, according to Avogadro's law, equal volumes of gases contain an equal number of molecules, the volume of oxygen consumed in the burning of this footstuff exactly equals the volume of carbon dioxide produced The respiratory quotient for carbohydrate, then, is $\frac{\text{volume } CO_2}{\text{volume } O_2} = 1$

Different quotients however, are obtained in the metabolism of fat and protein In the combustion of each of these, some of the oxygen consumed is used for purposes other than the production of carbon dioxide The volume of oxygen utilized therefore is greater than that of the carbon dioxide liberated with the result that the respiratory quotient for each of these two foodstuffs is less than unity When protein alone is metabolized the respiratory quotient is 0 80 For fat alone it is 0 71 A respiratory quotient intermediate between these figures indicates the combustion of a mixture of foodstuffs Under certain abnormal conditions the result may exceed in either direction the figures given Normally the lowest obtainable respiratory quotient is that of fat, 0 71, but still lower values are sometimes encountered An example of this is the respiratory quotient 0 613 reported in a case of diabetes This indicated that some of the absorbed oxygen was retained for purposes other than the production of carbon dioxide and water, a condition which obtains when amino acids are converted into glucose and as such are excreted in the urine for the glucose molecule contains more oxygen than the amino acid molecule The reverse of this is sometimes true, and a respiratory quotient as high as 1 20 may be found when, as in the fattening of the Strasbourg goose, glucose is converted into fat, which is stored as such In this process an oxygen rich substance is converted into an oxygen poor one with the net release of oxygen

The protein quota of the food metabolized can be computed from the nitrogen excreted in the urine by accepting that 1 gm of the latter

represents 6.25 gm. of protein. The burning of this quantity of average protein liberates 26.51 Calories. The destruction of this amount of protein is accompanied by the consumption of 8.49 gm. of oxygen and the liberation of 9.35 gm. of carbon dioxide, from which figures it is a simp[le] matter to compute the volume of these two gases involved in the metabolism of protein alone. Next, by subtracting these figures from the total, there can be obtained the respiratory quotient for carbohydrate and fat alone. Reference then to the table of Zuntz and Schumburg as modified by Lusk (Table 1), will tell the relative amounts of these two foodstuffs metabolized.

The following computation of this character was made by Richardson[10] upon the data obtained on a patient in the calorimeter:

| | |
|---|---|
| Urinary nitrogen | 0.202 gm. per hour |
| Total $CO_2$ | 16.29 gm. per hour |
| Total $O_2$ consumption | 16.00 gm. per hour |
| Protein Calories | $0.202 \times 26.51 = 5.35$ cal. |
| Protein $CO_2$ | $0.202 \times 9.35 = 1.89$ gm. |
| Protein $O_2$ | $0.202 \times 8.49 = 1.71$ gm. |

| | | | |
|---|---|---|---|
| Total $CO_2$ | 16.29 | Total $O_2$ | 16.00 |
| Protein $CO_2$ | 1.89 | Protein $O_2$ | 1.71 |
| Nonprotein $CO_2$ | 14.40 | | 14.29 |
| Change to liters | $\times$ 0.5089 | | $\times$ 0.699 |
| | 7.33 | | 10.0 |
| Nonprotein respiratory quotient | 0.733 | | |

Interpolating from Table 1, it may be seen that for a nonprotein respiratory quotient of 0.733, each liter of oxygen is the equivalent of 4.718 Calories.

$$10.0 \times 4.718 \text{ Cal.} = 47.2 \text{ nonprotein Cal.}$$

By such means it is possible from a knowledge of the oxygen consumed and the carbon dioxide and nitrogen eliminated to compute for a given period the exact amounts of carbohydrate, protein and fat that are destroyed. For clinical purposes, however, it is seldom necessary to compute protein metabolism from the nitrogen excreted, for experience has shown that it is sufficiently accurate to assume that 15 per cent of the calories of man's basal metabolism estimated fourteen hours after a meal are produced by protein and that the remaining calories are produced by the oxidation of carbohydrate and fat. For more detailed information the reader is referred to the extended discussions of Du Bois,[8] Lusk and Richardson.[10]

## Metabolism of Protein

Proteins are broken down in the stomach by pepsin and hydrochloric acid to proteoses and peptones, which in the small intestine are degraded by trypsin to polypeptides and finally by the peptidases to amino acids. About twenty-two amino acids are recognized; ten of these are known to be essential. Many proteins contain all of them, but others, such as gelatin, are lacking in certain essential amino acids and therefore a[re]

classed as incomplete These 'building stones,' as they are called, are absorbed by the intestinal villi and, circulating as such in the blood, are carried to the liver and the tissues In the former they are converted into plasma proteins, in the latter into tissue proteins This 'building stone analogy, however, is not entirely appropriate, for the body does not consist of fixed structures unchangeable in their several parts The proteins which make up these structures are in dynamic equilibrium and are believed to be in a constant state of flux

A better understanding of the many uses of protein in the animal economy is being reached through the fractionation of plasma proteins[12] At least thirty three protein components are now recognized There are several globulin fractions, each with its characteristic physical properties and apparently with its own specific physiologic function, such, for example, as the gamma fraction, which contains antibodies Proteins are used also for the synthesis of hormones, enzymes and other secretions, and some are metabolized to furnish energy In the catabolism of amino acids the carbon chain may enter the pathway of carbohydrate or ketone body metabolism, and the nitrogenous portion undergoes changes which may result in urea formation

The amount of glucose to which an amino acid is equivalent depends on its structure Some amino acids notably the straight chain acids with less than six carbon atoms such as alanine, permit all their carbon atoms to enter into the carbohydrate pathway while in others only a few of these atoms are so metabolized In this connection the following fact is useful in metabolic reckoning—1 gm of urinary nitrogen, which results from the metabolism of 6 25 gm of meat protein is accompanied in the urine of a completely diabetic or phlorhizinized animal by 3 65 gm of dextrose This observation is the basis of the assumption that 6 25 gm of meat protein may yield 3 65 gm of glucose (or 58 gm of glucose per 100 gm of protein) during metabolism This interpretation is useful in practical dietetics although it is an oversimplification of mechanism

The nitrogen containing $\alpha$ amino groups of the amino acids may be lost by a number of deaminating mechanisms Deamination occurs in both the liver and kidney The conversion of the nitrogen into urea takes place in the liver and is believed to occur through the arginine ornithine cycle Ammonia formation on the other hand, takes place in the kidney

For example,

s for the syn

thesis of choline or creatine Arginine is also involved in the synthesis of creatine Phenylalanine furnishes the nucleus for the synthesis of thyroxine Obviously amino acids serve specific metabolic roles in addition to the more general functions which were recognized in classical metabolic physiology

**The Synthesis of Protein** The value of a protein as a food is determined by the completeness with which it supplies all the amino acids needed as building stones for the proteins of the body are synthesized by the cells from the amino acids brought to them It is significant that these proteins are characteristic of the animal s own tissues, not of the

food proteins from which the building stones were derived; for this purpose, therefore, certain amino acids in specific quantities are needed. Those which are not needed are discarded, which explains the difficulty of maintaining nitrogen balance with small amounts of protein. True, certain of these amino acids can be synthesized from precursors already in the body and by intestinal bacteria, but this probably applies only to the simpler acids, such as aminoacetic acid, glutamic acid, alanine and others, not to the more complex bodies, such as tryptophan and lysine. The latter group may be termed "essential amino acids," since they must be provided by the proteins of the food. Those proteins which are lacking in this respect, of which gelatin is a notable example, will not suffice to maintain nitrogen equilibrium, but to a limited extent they will act as "protein sparers."

Feeding experiments have shown that while gelatin will spare a small amount of protein and during protein starvation will reduce the loss of tissue to a certain extent (up to 38 per cent), it will never completely prevent this loss. Indeed, when protein metabolism has been reduced to the minimal or "wear and tear" level, it is probable that this incomplete protein exerts no protective power. If, however, the two essential amino acids which are lacking, valine and tryptophan, and the two which are present only in extremely small amounts, tyrosine and cystine, are added in suitable quantities, then the mixture is capable of preserving complete nitrogen balance. Evidently, then, in order to compensate for wear and tear and to build new tissues, the body must receive from its protein food a complete supply of the proper building stones.

Furthermore, much evidence[13] indicates that effective tissue synthesis is dependent upon the simultaneous presence at the tissues of all amino acids required for the building of that tissue. This has been interpreted to stress the importance of the consumption of nutritionally complete proteins or mixtures at each meal.

The synthesis of protein, however, is not always accomplished by means of new material. It is probable that breakdown and resynthesis go hand in hand and that new protein for one tissue may be constructed from nitrogen derived from another. This is illustrated in the well-known behavior of the salmon: during a certain period of starvation and coincident reproductive activity the reproductive organs develop at the expense of the muscles.

**Nitrogen Balance.** If a person's intake of nitrogen equals his output, he is said to be in nitrogen equilibrium. If, however, the protein of his food does not provide sufficient nitrogen to cover that lost in the feces and in the urine, then he is in negative balance. If, because of growth, increased muscle development, the accumulation in the body of reserve protein or recuperation from disease or from starvation, his intake in this respect exceeds his output, then he is in positive nitrogen balance. The preservation of nitrogen equilibrium is a prime requirement of the adequate diet.

The intake of protein necessary to preserve equilibrium is never a fixed amount, for, according to the kind of diet, this can be maintained at varying levels of protein metabolism. With increased consumption of

protein the level at which nitrogen balance is attained tends to become constantly higher For example when a dog is given meat alone there is required for nitrogen equilibrium an intake which is three and a half times that of the protein metabolized during starvation but if to this meat diet are added other foodstuffs a much smaller amount of protein will suffice There is a distinction therefore in protein metabolism between a relative minimum and an absolute minimum

The relative minimum is the smallest amount of protein which with a fixed quantity of other foodstuffs will preserve nitrogen equilibrium This varies with the composition of the diet and the quality of the protein [11] The absolute minimum is the smallest intake of good protein at which equilibrium can be maintained under any circumstances This can be reached only when the person is in a satisfactory nutritive state and is living upon a diet which contains an optimum mixture of foodstuffs This is a diet which carries a sufficient amount of carbohydrate and fat and in which the former supplies at least half the total energy

Surprisingly low figures have been reported for this absolute minimum such for example as that for a well nourished person who maintains nutritive equilibrium on a diet of fat and potatoes which carried only 25 gm of protein but such exceptional figures have little practical application Experience has shown that under suitable conditions a man of 70 kilograms who eats an optimum mixture of carbohydrates and fats will require for nitrogen balance about 40 gm of protein daily [14,15] This figure is not to be regarded as a desirable standard of intake since it provides no reserves to cover unexpectedly increased demands It is widely accepted that an intake of 70 gm of protein per day for an adult is reasonable [16]

The preservation of nitrogen balance does not demand full adequacy of intake of all foodstuffs A diet which provides 60 to 70 gm of animal protein and 0 3 to 0 5 gm of carbohydrate per gram of protein will support nitrogen equilibrium even on a subcaloric regimen which permits weight loss of the obese patient [17,18]

**Protein Storage** Protein is held by the body for reserve purposes but probably not in the same sense in which carbohydrate and fat are stored The present concept as expressed by Whipple and Madden [19] is that the body maintains in dynamic equilibrium a large pool of circulating plasma and cell proteins These highly mobile factions are in constant exchange and are believed to be approximately equal in size The contributions to this pool may concern any body cell needing protein or capable of storing some surplus protein From this protein pool may be derived hemoglobin new plasma protein or cell protein The circulating plasma protein is the medium of exchange and the body is solvent just so long as there are adequate protein supplies for any emergency When the body becomes insolvent there may be a foreclosure due to disease infection or injury

For excellent discussions of the basic concepts of protein in nutrition the reader is referred to the reviews of Madden and Whipple [20] of Lewis[21] and of Rose [22] The symposium on plasma proteins edited by Youmans[12] provides a good account of knowledge in this field

## Metabolism of Carbohydrate

After the starches of the food have been hydrolyzed to disaccha in part by the amylase of the salivary glands and more completel like enzyme of the pancreas, these sugars are then split to mo charides by appropriate enzymes of the succus entericus. In the latter ess maltose is split into two molecules of glucose, sucrose into glucos fructose, and lactose into glucose and galactose. Little or no sugar sorbed from the stomach, all but a negligible amount being taken the intestine. Rates of absorption and the influence upon absorpti varying concentrations and of different mixtures of sugars have the subject of a great deal of discussion; it can be said generally tha disaccharides are taken up rather slowly and the monosaccharides rapidly. Among the latter, galactose is absorbed most rapidly, gl less so, and fructose rather slowly.[23] The absorption of these hexo effected through active processes of the cells of the intestinal vill which process phosphorylation plays an essential part; that of sugars is accomplished by simple diffusion.[24]

Glucose is the most important of the monosaccharides. After abs tion it may be stored as glycogen in either the liver or muscles. When need arises, liver stores of glycogen may, through the process of gl genolysis, give rise to glucose in the blood. This conversion of glyc to glucose involves phosphorolysis of the glycogen with the splittin the resultant transformed phosphate ester, glucose-6-phosphate, to cose. This reaction is mediated by the liver phosphatase. The enz phosphatase is absent from muscle; hence muscle glycogen cannot rise directly to blood glucose. Instead, the breakdown of muscle glyco yields lactic acid. It is beyond the scope of the present work to de the complexities of the intermediary metabolism of glucose in the tiss The interested reader is referred to the excellent treatment of this sub by Peters and Van Slyke[25] or by Stetten.[26]

Dietary carbohydrate is not the sole source of glycogen. Certain the amino acids and glycerol from fat may be precursors of it thro the process of glyconeogenesis. Intermediary products of carbohydr breakdown may be converted into other types of tissue components, i fat or protein.

Carbohydrate metabolism is adjusted by a variety of endocrine fact The hormones of the anterior pituitary inhibit directly the combusti of carbohydrate and, accordingly, exert a diabetogenic effect. Thus explained the ameliorating effect of hypophysectomy upon the dep creatized dog (Houssay).[27] The site of the anterior pituitary effect m be the inhibition of the enzyme hexokinase, which controls the conv sion of glucose to its 6-phosphate ester. Insulin appears to counter this inhibitory action, and thus indirectly to favor the necessary ph phorylation of glucose.[28] This reaction has not always been clea demonstrated.[29] Insulin favorably influences pyruvate utilization vitro.[30] It may compete with a pituitary factor for combination wi tissues, thus explaining in part the pituitary-insulin interaction.[31] A renal cortex insufficiency results in a hypoglycemia, diminished liver gl

cogen stores and, seemingly, a decreased glyconeogenesis from deaminized amino acids The hyperglycemic effect of epinephrine is due to accelerated hepatic glycogenolysis Hyperthyroidism may be associated with an increased absorption of sugar and an accelerated oxidation of carbohydrate

The chief function of carbohydrate in nutrition is to provide energy Under normal conditions it furnishes about two thirds of man's energy When carbohydrate is not available in the food, the body, after drawing heavily upon its stores of glycogen, breaks down tissue fat and protein

This facility exhibited by carbohydrate of being converted into glycogen greatly enhances its usefulness Glycogen is found in practically all organs of the body, but the chief storehouses are the liver and the muscles Although there is a maximum capacity for glycogen storage, the amount held in reserve varies rather widely, depending as it does largely upon the kind of food and the amount of exercise Man s ability to utilize stored glycogen has been estimated to vary from 93 to 232 gm [8] This furnishes a readily available source of energy which is rapidly drawn upon during continual or violent exercise Comment has been made, however, on the tenacity with which the muscle, particularly cardiac muscle, holds to its diminishing reserve of glycogen, for it is impossible to remove from the muscles all traces of this important substance except by inducing tetanic convulsions When sugars are absorbed in amounts in excess of the ability of the body to accumulate glycogen, they are converted into fat and so stored

Another important function of carbohydrate is its power to spare protein metabolism If an animal lives on nitrogenous food alone, it will require for nitrogen equilibrium three and a half times as much protein as would be metabolized during starvation, but if carbohydrate is added to the diet, the amount of meat necessary will be greatly reduced Even the low protein metabolism seen in starvation can be brought to a still lower level by the ingestion of carbohydrate Lusk cited the feeding experiments of Landergren, in which men were given diets consisting largely of carbohydrate and fat, with an extremely small amount of protein, which causes a condition called *specific nitrogen hunger* The urinary nitrogen output of these subjects, which during starvation was about 10 gm a day, was thus reduced through the protecting influence of the carbohydrate and fat to about 4 gm a day By a similar dietary maneuver, Smith was able to attain the extraordinarily low daily output of 1 58 gm of urinary nitrogen [32] The ingestion of fat alone has no such influence, for this foodstuff will not reduce the output of nitrogen below that of starvation Most effective in the sparing of protein is a mixture of carbohydrate and fat in which at least half the energy is supplied by the former Thus it is seen that when the food consists largely of carbohydrate a much lower level of protein metabolism can be obtained than is experienced when the diet is of protein or fat alone or of both

## Metabolism of Fat

The digestion and absorption of fat have been discussed (pp 8 9) The body fat is synthesized from dietary fat and from carbohydrate and,

to a limited extent protein It assumes a composition characteristic for the animal and location unless excessively large quantities of a fat are ingested

In a consideration of the oxidation of fat one must distinguish the glycerol and fatty acid moieties Glycerol is metabolized as a carbohydrate the fatty acids by a variety of processes which involve oxidation or addition of two carbon fragments The classical oxidative breakdown by means of *β-oxidation* allows one to visualize the formation of the metabolic products known as ketone bodies β hydroxybutyric acid acetoacetic acid and acetone These normal intermediates are formed in the liver and oxidized further by the extrahepatic tissues When carbohydrate oxidation is deficient as in diabetes starvation and the like an excessive metabolism of fat increases the ketone body production beyond the capacity to destroy these substances and ketosis results These ketone bodies are acidic and must be excreted in the urine in combination with a cation The interconversion of fat with other foodstuffs is through the two-carbon fragment Fat is no longer regarded as an inert mass subject only to combustion, but rather is looked upon as a great metabolic pool which is continually drawn upon or added to for a variety of purposes [33]

In addition to the true fats other lipids in the body include cholesterol and its esters lipids which contain nitrogenous bases with or without phosphorus and the fat soluble vitamins and provitamins The animal body can synthesize all of these except the vitamins provitamins and the more unsaturated fatty acids ( essential fatty acids ) Choline for phospholipid formation can be synthesized if the proper precursors are provided

The value of fat as a constituent of the diet has in the past been attributed solely to its relatively high caloric value By contributing to the organism a large amount of energy, it relieves the intestinal tract of the necessity for dealing with an excessive amount of carbohydrate food and to a certain extent it spares protein The value of fat does not stop here It aids in the digestive functions favors absorption of fat soluble factors and provides substances essential for the animal economy This last was demonstrated by Burr and Burr[34] when they found that independently of the vitamin supply skin lesions and other evidences of disease appear regularly in rats fed upon a ration devoid of certain unsaturated fatty acids Hansen and Burr[35] state that the careful exclusion of these essential fatty acids in the diet of rats produces (1) the development of a scaly skin and caudal necrosis (2) marked retardation of growth (3) increased consumption of water and (4) death Other less specific effects attributed to this type of deficiency are histologic changes in the ovaries and other tissues sterility in both male and female and high metabolic rates These disabilities can be avoided by the addition to the diet of either of two unsaturated fatty acids linoleic or arachidonic another acid linolenic will bring about renewed growth in rats but will not cure the skin disease Since linoleic acid is of plant origin and arachidonic is of animal origin it seems proper to regard the former as the primary dietary essential [36]

In man no evidence has been presented to show that lack of the essential fatty acids will produce similar disorders The iodine number (a measure of degree of unsaturation) of the serum lipids decreases on a diet low in unsaturated fatty acids[37] This may indicate a limited ability of the human being to synthesize these essential fatty acids but final decision on this point must await more conclusive studies Infantile eczema may be associated with moderately decreased serum content of unsaturated lipids If the human being requires dietary sources of fatty acids, it is fortunate that they are distributed widely among foods[38]

For further information the reader is referred to the special articles of Hansen and Burr[35] and of Eckstein[39] and to the review by Stadie[40]

### The Specific Dynamic Action of Food

The basal metabolism is the heat production of a man quietly resting completely relaxed but awake, at a comfortable environmental temperature, and in a postabsorptive state (at least eighteen hours postprandially) If these conditions are maintained, except that food be ingested, the heat production will be increased above the basal level This stimulus which a foodstuff gives to metabolism is known as its *specific dynamic action* (SDA) It is now believed that this term is generic rather than specific and that it includes several unrelated forms of heat production which may be stimulated by food It is exhibited to a notable degree by protein and to a less extent by carbohydrate and fat

If the basal metabolism of a hypothetical animal be 100 Calories per day, and if 100 Calories be administered to the animal (maintained in the basal state) as each of the three foodstuffs on different days the heat production (basal metabolism plus specific dynamic action) of the animal after receiving meat protein will rise to about 130 Calories after glucose to about 106 Calories and after fat to about 104 Calories[41] Obviously to preserve nutritive equilibrium the fed animal requires a greater caloric intake than the mere basal metabolism The practical application of this fact is apparent

The specific dynamic action of protein is related to the metabolism of its constituent amino acids it appears that in a properly nourished animal it is the sum of their separate effects Wilhelmj[40] has stated that the specific dynamic action of the amino acids can best be characterized by certain negations It is not due to the heat that comes from the direct combustion of amino acids per se it does not come from the direct stimulation of the tissues by the unchanged acids and it is not due to the secretory activities or the muscular movements of the intestinal tract The prevailing opinion based on the investigations of Wilhelmj Bellman and Mann and of Lundsgaard[42] is that the specific dynamic action of the amino acids is related to deamination specifically to the formation of urea or to the stimulating effect of the ammonia produced in this reaction

It is noteworthy that the specific dynamic action is not exerted when protein is retained for structural purposes or as reserve protein Lusk[41] cited evidence that in undernutrition a mixed diet designed to meet the

exact needs of the tissues and introduced slowly by absorption from the intestine is virtually without specific dynamic action. This is of practical application in dietary computations.

Carbohydrate and fat also exert a specific dynamic action, but probably in a different manner from that of protein. The generally accepted plethora theory by which Lusk explained the specific dynamic action of fat has been disputed by Murlin and his associates,[43] partly on the ground that this action does not run parallel to blood fat. The authors just cited state that a strong dynamic effect from sugar may be obtained without any evidence of its own combustion. There is reason for believing, at least under conditions of fasting with reduced glycogen stores, that the specific dynamic action of carbohydrate is due to the conversion of glucose to glycogen. Even water has some such dynamic action, owing possibly to increased work of the kidneys.

A heavy meal of protein and carbohydrate, according to Du Bois and Chambers,[7] in two or three hours may increase metabolism 30 to 40 per cent above the fasting level. The rise is less pronounced after an ordinary meal, but, spread over twenty-four hours, the specific dynamic action will amount to about 6 per cent of the caloric value of food. Forbes and Swift[44] expressed the view that the assumption of an additive effect of the dynamic action of the several foods of a mixed diet is not universally acceptable. On the basis of their experiments these workers conclude that "the dynamic effects of individual foods or nutrients are without significance as constants." If these findings on animals are confirmed on man, the additive method of calculation used by Lusk[45] will require revision. For a more complete discussion of this subject the reader is referred to the reviews of Lusk[41] and of Wilhelmj.[42]

### Interconversion of Foodstuffs

The conversion of protein into carbohydrate, which regularly takes place to the extent of 58 per cent of the former, has already been discussed. The amino acids which lend themselves to this purpose are converted first into intermediary products and then into glucose. Equally well known is the transformation of carbohydrate into fat. This last can be looked upon as an accessory mechanism for accumulating reserve stores of fuel, but the method by which such transformation takes place is not definitely known. Stetten[26] states that the pathways of carbohydrate, fat and protein catabolism cross at so many points that, within wide limits, one nutrient may without significant injury to the metabolizing tissues be substituted for another. "As this fusion of metabolic pathways has been elucidated the classic lines of demarcation between the metabolism of fat, protein and carbohydrate have become progressively more obscure and more meaningless."

Rapport,[46] in his excellent review, states that there is every evidence that the conversion of carbohydrate into fat is associated with little change in energy content. The reverse of this, the conversion of fat into carbohydrate, is theoretically possible. The weight of evidence, however, notably that offered by Stadie and his co-workers,[47] is against such conversion.

## Heat Regulation

The warm blooded animal maintains a constant body temperature even though the surrounding atmosphere may vary within extreme limits of heat and cold This constancy of temperature is preserved by balancing two factors the one against the other (*a*) heat production and (*b*) heat elimination The former is dependent upon chemical reactions and is spoken of as chemical regulation, the latter is controlled by physical factors and constitutes physical regulation

**Heat Production** The heat of the body comes almost entirely from the oxidation of food An increased intake of carbohydrate and fat results in an increased production of heat, but not all this food is thus utilized, since when eaten in excess some of it is stored as fat The intake of food especially of protein leads directly to an increased production of heat through its specific dynamic action This heat is utilizable for maintaining the body temperature If the temperature of the surrounding medium is low and there is a demand for heat, reflex impulses arising in the skin lead to increased metabolic activity, with resulting increased production of heat If the temperature goes still lower, this leads to the involuntary movements of the muscles known as shivering which increases the metabolism yielding still more heat Voluntary muscular activity has a like result A cold bath will accomplish the same thing through the stimulus it gives to metabolic activity When the temperaure of the surrounding air approximates that of the body, chemical regulation remains in abeyance

**Heat Loss** Heat is lost from the body by radiation, convection conduction evaporation of water from the skin and lungs and loss of heat in the excreta The loss through evaporation is based upon the heat required to transform water to the gaseous state ('latent heat of vaporization') which at body temperature amounts to 0 58 calories per gram The relative importance of each of these four routes for the dissipation of body heat depends upon a variety of factors among the more important of which are environmental temperature humidity presence of air currents kind of clothing and presence or absence of fever The importance of these factors in applied physiology of clothing care and feeding in the tropics arctic regions and deserts has been extensively treated in the monographs of Newburgh [48] of Adolph and associates,[49] and of Mitchell and Edman [50]

It may be estimated that a comfortably clothed man doing ordinary work with a daily energy production of some 3000 Calories will dissipate the heat approximately as follows [51]

| | *Calories* | *Percentage* |
|---|---|---|
| Radiation convection and conduction | 2100 | 70 |
| Evaporation from skin and lungs | 810 | 27 |
| Warming inspired air | 60 | 2 |
| Urine and feces (i e heat of the excreta over that of the food) | 30 | 1 |
| Total daily heat loss | 3000 | 100 |

When the necessity develops for increased loss of heat, there is an increased flow of blood to the animal s skin where through the dilated

capillaries, it is exposed to the cooling effect of the surrounding atmosphere. When to this is added an outpouring of sweat, with increased evaporation from the skin, the heat loss becomes still greater. If the air is hot and dry, a larger proportion of heat is lost through sweating and evaporation.

Heat is conserved, on the other hand, by the kind of the animal's covering. The layers of fat in the subcutaneous tissues, the air contained in the hair or fur of the skin and, in man, the clothing all *limit radiation* and convection. Under certain circumstances physical regulation may fail altogether. If the temperature of the surrounding medium is 36° C or above, *convection leads heat into the body*, and evaporation of sweat becomes the only means available for keeping the skin and the underlying tissues cool. If, in addition, the relative humidity of the atmosphere is 100 per cent or more, or if the clothing prevents effective vaporization, then under these circumstances there is no alternative but a rise in body temperature. Under ordinary circumstances, however, the physical control of body heat is remarkably labile and efficient.

Recommended presentations of the basic principles of heat exchange and energy relationships are the syllabus of Newburgh, Johnston and Newburgh,[52] the reviews of Newburgh and Johnston,[53] and of Du Bois and Chambers.[7] More extensive valuable discussions are those of Du Bois[54] and the remarkable monograph of Brody.[55]

## Neutrality Regulation and Molecular Concentration

For the maintenance of life and the proper performance of function the cells must be surrounded by a medium which at all times maintains an unchanging reaction and fixed molecular concentration.

**Neutrality Regulation.** Distilled water, which is neutral in reaction, contains a certain number of dissociated hydrogen (H) and hydroxyl (OH) ions. One liter of distilled water contains 0.0000001 $\left(\frac{1}{10\,000\,000}\right)$ gm. of free hydrogen ions, which, in order to avoid fractions, is usually expressed in the negative logarithm $10^{-7}$ or, taking the symbol commonly used, $pH = 7$. This represents exact neutrality. A hydrogen ion concentration less than this (higher *p*H value) indicates alkalinity, a greater concentration (lower *p*H value) acidity.

*The reaction of the blood in health*, which is just on the alkaline side of neutrality, ranges between *p*H 7.35 and 7.45. The *p*H of the urine varies over a wide range of approximately 4.8 to 8.0. The chief factor which determines the reaction of the urine is the type of food consumed. Medication, of course, may alter urinary *p*H; certain physiologic processes, such as the secretion of gastric acid, are responsible for shifts in the *p*H of the urine.

Details of neutrality regulation cannot be presented here, but the interested reader will find the syllabus by Gamble[56] invaluable. Suffice it to recall that the faculty to maintain a constant internal environment is due to (1) the efficient system of buffers in the blood, which allow the transport of acidic and basic metabolites with but minimal influence on the hydrogen ion concentration, (2) the properties of hemoglobin, in

cluding the abilities to combine with carbon dioxide to form a carbamate derivative (3) the presence in erythrocytes and tissues of carbonic an hydrase the enzyme which accelerates the reaction $CO_2 + H_2O = H_2CO_3$ (4) the ease with which the elimination of carbon dioxide by the lungs may be altered under the influence of the respiratory center and (5) the dual role of the kidneys in (*a*) excreting urine of varying *p*H (depending especially upon the relative amount of disodium and monosodium acid phosphate excreted) and (*b*) synthesizing and excret ing ammonia to combine with excreted acid to conserve sodium and potassium An oversimplified picture of this remarkable regulatory mechanism is that the immediate shock of products of cellular activity is absorbed by mechanisms (1) (2) and (3) and transmitted with mini mal alteration of the body fluid to the exterior through mechanisms (4) and (5*a b*)

The processes concerned in the preservation of acid base balance are accompanied by a small but constant loss of basic elements to the body To meet this drain the blood draws on the cations ($Na^+$ and $K^+$) of the tissues This store of basic elements is not unlimited and in the last analysis the loss must be made good by the food Sherman and Gettler[57] first called attention through their ash analyses to the respective base forming or acid forming qualities of the different foods and they pointed out the importance of these qualities in the animal economy

Foods are classified as acid forming or base forming with regard to the result of their ingestion upon the *p*H of the urine An acid forming food is a food which when ingested will be metabolized to end products which bring about a lowering of the *p*H of the urine Base forming foods have the opposite effect The oxidation of meat or fish leaves a residue of phosphate sulfate and chloride to be ex creted This influences the reaction of the urine towards a lowering of the *p*H hence meat and fish are acid forming or acid residue foods Vegetables and fruits usually leave an ash or residue consisting of an ex cess of cations as sodium or potassium and are termed alkaline residue or base forming foods Some organic acids present in certain foods are excreted as such or conjugated as organic acids for example benzoic acid is excreted as hippuric acid Food supplying large quantities of these acids are also acid forming foods These qualities of food have been studied by Blatherwick[58] who discussed the influence of base forming and of acid forming diets on the urine He stated that potatoes oranges raisins apples bananas and cantaloupes are excellent base sup plying foods and that plums prunes and cranberries because of the ben zoic acid which they contain are acidic in their influence

The beneficial effects of foods which are predominantly basic espe cially in nephritis have been discussed in a practical way by Sansum Blatherwick and Smith[59] This will be reviewed more fully in Chapter 19 in which tables of acid forming and base forming foods will be given

**Molecular Concentration** The animal cell requires a surrounding medium which contains salts of sufficient molecular concentration to maintain in this fluid a certain osmotic pressure The osmotic pressure of extracellular fluid is almost entirely due to its ionic content nonelec

trolytes contribute a nearly negligible portion. The colloids (protein) of the blood are of importance, for when the plasma protein concentration falls to about one half the usual level, edema occurs. The cations (i.e., minerals) are of particular importance, for they determine the ionic concentration of the fluid. The concentration of anions (primarily $HCO_3^-$) is more readily adjustable. The sum of anions is always equal to the sum of cations. Sodium is the chief cation; hence its content largely determines the osmotic value of the extracellular fluid.

While sodium is the chief cation of extracellular fluids, potassium is the primary cation of the intracellular compartment. Sodium and potassium do not readily exchange across the cellular boundaries; therefore, osmotic adjustments to equalize extracellular and intracellular osmotic relationships are accomplished through the transfer of water from one compartment to the other.

The extracellular fluid compartment is composed of the blood plasma (intravascular compartment) and the interstitial fluid (extravascular compartment). The former is about 5 per cent of the body weight; the latter is 15 to 20 per cent. The intracellular fluid compartment makes up some 50 per cent of the body weight.

The maintenance of the size and composition of these fluid compartments is of great importance,[52,50] especially in considerations of parenteral alimentation, and will be discussed at appropriate places in the text.

The chemistry and physics of neutrality regulation and osmotic effects are treated in a number of useful reviews.[52,56,60–63]

## Metabolism of the Cell

Thus far we have considered the gross exchanges which food undergoes during utilization—those features which can be studied directly in the intact animal or human subject. The digestion, absorption and net physiologic utilization have been outlined. Absorbed foodstuffs are transported to the cell via the extracellular fluids, and the metabolic products are swept from the cell to the organs of excretion by these same fluids. We have touched upon the protective mechanisms which maintain the narrow range of reaction and osmotic relationships which are demanded for the central metabolic unit—the cell. It is within this cell that the major transformations of a nutrient occur—oxidation, release of energy, synthesis, interconversion or storage.

These transformations are mediated primarily through the activity of intracellular enzymes, which are specific proteins with or without identifiable active groups. When these groups are readily separable from the protein, they are termed *prosthetic groups*. The prosthetic group of many important cellular enzymes incorporates a vitamin or vitamin derivative. Many enzymes require the presence of metal ions in order to become active. Cellular metabolism is regulated by hormones. Thus the cell becomes the locus of interplay of major foodstuffs, of vitamins, minerals and of hormones. Surface and boundary phenomena are present within cells, but their metabolic significance has not been clearly defined.

A discussion of the minutiae of cellular conversions would be out of place here.

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# 3

## *Fuel Requirement*

Of the methods adapted to the estimation of energy requirement of an individual, the factorial approach is the one most widely used. This consists in adding together the calories needed to satisfy the requirements for (*a*) basal metabolism, (*b*) specific dynamic action of food, (*c*) work, (*d*) temperature regulation, and (*e*) growth. It must be recognized that the estimates of the fuel consumed by the last three of these are subject to inaccuracies; hence the method provides but an approximation of the actual requirement unless elaborate measurements can be made. Basal metabolism was discussed in Chapter 2, where it was explained that the basal metabolic rate is directly proportionate to the surface area or to some other factor, such as the protoplasmic mass, which in itself is proportionate to the surface area, and that for accurate measurement the body surface should be taken as the criterion.

**Table 2. Calories per Square Meter of Body Surface per Hour (Height-Weight Formula) (Aub and Du Bois)**

| Age, Years | Males | Females |
|---|---|---|
| 14–16 | 46.0 | 43.0 |
| 16–18 | 43.0 | 40.0 |
| [illegible] | [illegible] | 38.0 |
| [illegible] | [illegible] | 37.0 |
| [illegible] | [illegible] | 36.5 |
| 40–50 | 38.5 | 36.0 |
| 50–60 | 37.5 | 35.0 |
| 60–70 | 36.5 | 34.0 |
| 70–80 | 35.5 | 33.0 |

**Surface Area.** Several formulas have been devised for estimating the surface area; the most accurate and the one now in general use is Du Bois'[1] "height-weight formula." From this formula Du Bois devised the chart shown herewith (Fig. 2). The vertical lines represent height and the horizontal lines weight. The point where these lines intersect is located, and the proximity of this point to the nearest curved line will give the surface area.

For children, Benedict and Talbot have estimated the surface area as shown in Table 3.

**Basal Metabolic Rate.** After the surface area has been determined, it becomes necessary to find the basal metabolic rate for the subject's age

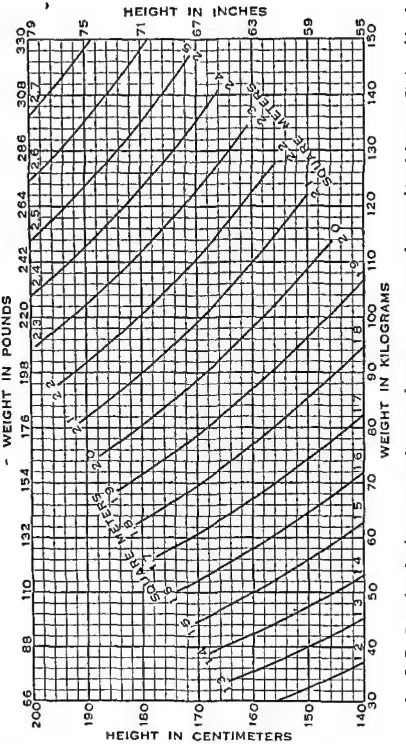


Fig 2 Du Bois chart for determining surface area of man in square meters from weight in kilograms (Wt) and height in centimeters (Ht) according to the formula Area (sq cm) $= Wt^{0.425} \times Ht^{0.725} \times 71.84$

Table 3. Estimated Body Surfaces for Body Weights from Three to Forty Kilograms (Benedict and Talbot)

| Body Weight (without Clothing), Kilograms | Surface Estimated for Boys, Sq M | Surface Estimated for Girls, Sq M | Body Weight (without Clothing), Kilograms | Surface Estimated for Boys, Sq M. | Surface Estimated for Girls, Sq M. | Body Weight (without Clothing), Kilograms | Surface Estimated for Boys, Sq M | Surface Estimated for Girls, Sq M |
|---|---|---|---|---|---|---|---|---|
| 3 | 0.208 | 0.210 | 16 | 0.711 | 0.686 | 29 | 1.086 | 1.048 |
| 4 | 0.252 | 0.255 | 17 | 0.740 | 0.714 | 30 | 1.110 | 1.072 |
| 5 | 0.292 | 0.295 | 18 | 0.769 | 0.742 | 31 | 1.134 | 1.095 |
| 6 | 0.330 | 0.333 | 19 | 0.797 | 0.769 | 32 | 1.159 | 1.119 |
| 7 | 0.388 | 0.388 | 20 | 0.825 | 0.796 | 33 | 1.183 | 1.142 |
| 8 | 0.424 | 0.424 | 21 | 0.853 | 0.845 | 34 | 1.207 | 1.164 |
| 9 | 0.459 | 0.459 | 22 | 0.879 | 0.872 | 35 | 1.230 | 1.188 |
| 10 | 0.492 | 0.492 | 23 | 0.906 | 0.898 | 36 | 1.254 | 1.210 |
| 11 | 0.524 | 0.534 | 24 | 0.932 | 0.924 | 37 | 1.277 | 1.233 |
| 12 | 0.556 | 0.566 | 25 | 0.958 | 0.949 | 38 | 1.300 | 1.255 |
| 13 | 0.586 | 0.597 | 26 | 1.009 | 0.974 | 39 | 1.323 | 1.277 |
| 14 | 0.616 | 0.627 | 27 | 1.035 | 0.999 | 40 | 1.345 | 1.298 |
| 15 | 0.645 | 0.657 | 28 | 1.060 | 1.024 | | | |

and sex. The variation in rate according to age and sex has been studied by a number of investigators, and a variety of standards is in use. The standards of Aub and Du Bois[2] (Table 2) and of Boothby, Berkson and Dunn[3] (Table 4 and Fig. 1) are some 5 to 8 per cent higher than actual physiologic basal levels,[4] since they are derived from observations on untrained subjects. The differences in basal metabolism with age and sex were pointed out in Chapter 2.

The validity of the surface area law has been questioned by Benedict and Harris,[5] who devised the following "prediction formula" for basal metabolism related to body weight:

Where, $h$ = total heat production in 24 hours
$w$ = weight in kilograms
$s$ = stature in centimeters
$a$ = age in years

the formula may be written—

For men $h = +66.473 + 13.7516w + 5.0033s - 6.7550a$

For women $h = +655.0955 + 9.5634w + 1.8496s - 4.6756a$

The calculations involved in the Harris-Benedict method are complicated, but Roth has reduced these to the shorter tables reproduced herewith (Table 5) from the book by Du Bois.[6] These standards are about 3 per cent higher than one obtains with trained subjects.[4]

The basal metabolism of children, because of the wide variations in their physiologic standards, is not so readily determined. Talbot,[7] in summarizing his studies, writes that the standards for body surface that were used for adult patients gave surprisingly accurate information, but were not satisfactory for children. As a result of many years of investi-

Table 4 Standards for Basal Metabolism, Mean Calories Per Square Meter (Du Bois) Per Hour. Values for Age As of Last Birthday (Boothby, Berkson, and Dunn[3])

| Age Last Birth day | Calories per Square Meter per Hour | | | | Age Last Birth day | Calories per Square Meter per Hour | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Males | | Females | | | Males | | Females | |
| | Mean | Standard Deviation | Mean | Standard Deviation | | Mean | Standard Deviation | Mean | Standard Deviation |
| Years | | | | | Years | | | | |
| 6 | 53.0 | 3.2 | 50.5 | 2.9 | 41 | 38.2 | 2.3 | 35.5 | 2.2 |
| 7 | 52.4 | 3.2 | 48.5 | 2.9 | 42 | 38.0 | 2.3 | 35.5 | 2.2 |
| 8 | 51.5 | 3.2 | 46.7 | 2.9 | 43 | 37.9 | 2.3 | 35.4 | 2.2 |
| 9 | 49.9 | 3.2 | 46.1 | 2.9 | 44 | 37.7 | 2.3 | 35.4 | 2.2 |
| 10 | 48.0 | 3.2 | 45.7 | 2.9 | 45 | 37.6 | 2.3 | 35.3 | 2.2 |
| 11 | 47.2 | 3.2 | 45.1 | 2.9 | 46 | 37.5 | 2.3 | 35.1 | 2.2 |
| 12 | 46.8 | 3.2 | 43.9 | 2.9 | 47 | 37.4 | 2.3 | 34.9 | 2.2 |
| 13 | 46.5 | 3.2 | 42.5 | 2.9 | 48 | 37.2 | 2.3 | 34.7 | 2.2 |
| 14 | 46.4 | 3.2 | 41.1 | 2.9 | 49 | 37.1 | 2.3 | 34.6 | 2.2 |
| 15 | 46.1 | 3.2 | 39.7 | 2.9 | 50 | 37.0 | 2.3 | 34.4 | 2.2 |
| 16 | 45.5 | 3.1 | 38.6 | 2.8 | 51 | 36.8 | 2.3 | 34.2 | 2.2 |
| 17 | 44.4 | 3.0 | 37.6 | 2.7 | 52 | 36.7 | 2.3 | 34.0 | 2.2 |
| 18 | 42.9 | 2.8 | 37.0 | 2.6 | 53 | 36.6 | 2.3 | 33.8 | 2.2 |
| 19 | 42.2 | 2.7 | 36.6 | 2.6 | 54 | 36.5 | 2.3 | 33.6 | 2.2 |
| 20 | 41.6 | 2.5 | 36.3 | 2.5 | 55 | 36.3 | 2.3 | 33.4 | 2.2 |
| 21 | 41.2 | 2.4 | 36.2 | 2.4 | 56 | 36.2 | 2.3 | 33.3 | 2.2 |
| 22 | 40.9 | 2.3 | 36.1 | 2.3 | 57 | 36.1 | 2.3 | 33.2 | 2.2 |
| 23 | 40.7 | 2.3 | 36.1 | 2.2 | 58 | 36.0 | 2.3 | 33.1 | 2.2 |
| 24 | 40.5 | 2.3 | 36.0 | 2.2 | 59 | 35.8 | 2.3 | 32.9 | 2.2 |
| 25 | 40.3 | 2.3 | 36.0 | 2.2 | 60 | 35.7 | 2.3 | 32.8 | 2.2 |
| 26 | 40.1 | 2.3 | 35.9 | 2.2 | 61 | 35.6 | 2.3 | 32.8 | 2.2 |
| 27 | 40.0 | 2.3 | 35.9 | 2.2 | 62 | 35.5 | 2.3 | 32.7 | 2.2 |
| 28 | 39.9 | 2.3 | 35.9 | 2.2 | 63 | 35.4 | 2.3 | 32.6 | 2.2 |
| 29 | 39.7 | 2.3 | 35.9 | 2.2 | 64 | 35.3 | 2.3 | 32.5 | 2.2 |
| 30 | 39.6 | 2.3 | 35.8 | 2.2 | 65 | 35.1 | 2.3 | 32.4 | 2.2 |
| 31 | 39.5 | 2.3 | 35.8 | 2.2 | 66 | 35.0 | 2.3 | 32.3 | 2.2 |
| 32 | 39.3 | 2.3 | 35.8 | 2.2 | 67 | 34.9 | 2.3 | 32.3 | 2.2 |
| 33 | 39.2 | 2.3 | 35.7 | 2.2 | 68 | 34.8 | 2.3 | 32.3 | 2.2 |
| 34 | 39.1 | 2.3 | 35.7 | 2.2 | 69 | 34.7 | 2.3 | 32.2 | 2.2 |
| 35 | 38.9 | 2.3 | 35.7 | 2.2 | 70 | 34.5 | 2.3 | 32.2 | 2.2 |
| 36 | 38.8 | 2.3 | 35.6 | 2.2 | 71 | 34.4 | 2.3 | 32.1 | 2.2 |
| 37 | 38.7 | 2.3 | 35.6 | 2.2 | 72 | 34.1 | 2.3 | 32.1 | 2.2 |
| 38 | 38.5 | 2.3 | 35.6 | 2.2 | 73 | 33.9 | 2.3 | 32.1 | 2.2 |
| 39 | 38.4 | 2.3 | 35.6 | 2.2 | 74 | 33.7 | 2.3 | 32.0 | 2.2 |
| 40 | 38.3 | 2.3 | 35.5 | 2.2 | 75 | 33.4 | 2.3 | 32.0 | 2.2 |

gation he has adopted, as more accurate, a standard of total calories for weight supplemented by that of total calories for height or, in other words, the total calories for the "expected weight" These figures vary in certain cases rather widely from those obtained by Webster and his associates[8] in their studies of adolescent boys and girls, these authors place greater reliance on the standards of Bierring for boys and on those of Kestner and Knipping for girls Standards for children are presented in Chapter 12.

Table 5. Normal Standards* (Roth)

Harris Benedict Standards Based on Body Weight

| Weight, kg | Calories per Hour Males | Calories per Hour Females | Weight, kg | Calories per Hour Males | Calories per Hour Females |
|---|---|---|---|---|---|
| 10 | 8.5 | .. | 72 | 44.0 | 56.0 |
| 12 | 9.7 | .. | 74 | 45.2 | 56.8 |
| 14 | 10.8 | . | 76 | 46.3 | 57.6 |
| 16 | 12.0 | | 78 | 47.5 | 58.4 |
| 18 | 13.1 | | 80 | 48.6 | 59.2 |
| 20 | 14.3 | . | 82 | 49.7 | 60.0 |
| 22 | 15.4 | . | 84 | 50.9 | 60.8 |
| 24 | 16.6 | .. | 86 | 52.0 | 61.6 |
| 26 | 17.7 | 37.6 | 88 | 53.2 | 62.4 |
| 28 | 18.8 | 38.4 | 90 | 53.3 | 63.2 |
| 30 | 19.9 | 39.2 | 92 | 55.5 | 64.0 |
| 32 | 21.1 | 40.0 | 94 | 56.6 | 64.8 |
| 34 | 22.2 | 40.8 | 96 | 57.8 | 65.6 |
| 36 | 23.4 | 41.6 | 98 | 58.9 | 66.4 |
| 38 | 24.5 | 42.4 | 100 | 60.1 | 67.2 |
| 40 | 25.7 | 43.2 | 102 | 61.2 | 68.0 |
| 42 | 26.8 | 44.0 | 104 | 62.4 | 68.8 |
| 44 | 28.0 | 44.8 | 106 | 63.5 | 69.6 |
| 46 | 29.1 | 45.6 | 108 | 64.7 | 70.4 |
| 48 | 30.3 | 46.4 | 110 | 65.8 | 71.2 |
| 50 | 31.4 | 47.2 | 112 | 67.0 | 72.0 |
| 52 | 32.6 | 48.0 | 114 | 68.1 | 72.8 |
| 54 | 33.7 | 48.8 | 116 | 69.3 | 73.6 |
| 56 | 34.9 | 49.6 | 118 | 70.4 | 74.4 |
| 58 | 36.0 | 50.4 | 120 | 71.6 | 75.2 |
| 60 | 37.2 | 51.2 | 122 | 72.7 | 76.0 |
| 62 | 38.3 | 52.0 | 124 | 73.9 | 76.8 |
| 64 | 39.5 | 52.8 | 126 | 75.0 | 77.6 |
| 66 | 40.6 | 53.6 | 128 | 76.1 | 78.4 |
| 68 | 41.8 | 54.4 | 130 | 77.2 | 79.2 |
| 70 | 42.9 | 55.2 | | | |

Harris Benedict Standards Based on Age and Stature—Men

| Cm | Age 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 150 | 25.6 | 24.2 | 22.8 | 21.4 | 20.0 | 18.6 | 17.2 | 15.8 | 14.4 | 13.0 | 11.6 |
| 155 | 26.6 | 25.2 | 23.8 | 22.4 | 21.0 | 19.6 | 18.2 | 16.8 | 15.4 | 14.0 | 12.6 |
| 160 | 27.7 | 26.3 | 24.9 | 23.5 | 22.1 | 20.7 | 19.3 | 17.9 | 16.5 | 15.1 | 13.7 |
| 165 | 28.7 | 27.3 | 25.9 | 24.5 | 23.1 | 21.7 | 20.3 | 18.9 | 17.5 | 16.1 | 14.1 |
| 170 | 29.8 | 28.4 | 27.0 | 25.6 | 24.2 | 22.8 | 21.4 | 20.0 | 18.6 | 17.2 | 15.8 |
| 175 | 30.8 | 29.4 | 28.0 | 26.6 | 25.2 | 23.8 | 22.4 | 21.0 | 19.6 | 18.2 | 16.8 |
| 180 | 31.9 | 30.4 | 29.1 | 27.6 | 26.2 | 24.8 | 23.4 | 22.0 | 20.6 | 19.2 | 17.8 |
| 185 | 32.9 | 31.5 | 30.1 | 28.7 | 27.3 | 25.9 | 24.5 | 23.1 | 21.7 | 20.3 | 18.9 |
| 190 | 34.0 | 32.5 | 31.2 | 29.7 | 28.3 | 26.9 | 25.5 | 24.1 | 22.7 | 21.3 | 19.9 |
| 195 | 35.0 | 33.6 | 32.2 | 30.8 | 29.4 | 28.0 | 26.6 | 25.2 | 23.8 | 22.4 | 21.0 |
| 200 | 36.1 | 34.6 | 33.2 | 31.8 | 30.4 | 29.0 | 27.6 | 26.2 | 24.8 | 23.4 | 22.0 |

* The predicted calories per hour are obtained by adding the calories corresponding to the weight in kilograms to the calories corresponding to age and stature. In the use of *these condensed tables, interpolation is necessary*

Table 5 *(Continued)*

Harris Benedict Standards Based on Age and Stature—Women

| Cm | Age 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 150 | 7 7 | 6 7 | 5 7 | 4 7 | 3 8 | 2 8 | 1 8 | 0 9 | 0 0 | −1 0 | −2 0 |
| 155 | 8 1 | 7 1 | 6 1 | 5 1 | 4 2 | 3 2 | 2 2 | 1 2 | 0 2 | −0 7 | −1 7 |
| 160 | 8 5 | 7 5 | 6 5 | 5 5 | 4 5 | 3 6 | 2 6 | 1 6 | 0 6 | −0 3 | −1 3 |
| 165 | 8 8 | 7 8 | 6 9 | 5 9 | 4 9 | 4 0 | 3 0 | 2 0 | 1 0 | 0 0 | −0 9 |
| 170 | 9 2 | 8 2 | 7 3 | 6 3 | 5 3 | 4 3 | 3 4 | 2 4 | 1 4 | 0 5 | −0 5 |
| 175 | 9 6 | 8 6 | 7 6 | 6 7 | 5 7 | 4 7 | 3 7 | 2 8 | 1 8 | 0 8 | −0 2 |
| 180 | 10 0 | 9 0 | 8 0 | 7 0 | 6 1 | 5 1 | 4 1 | 3 2 | 2 2 | 1 2 | 0 2 |
| 185 | 10 4 | 9 4 | 8 4 | 7 5 | 6 5 | 5 5 | 4 5 | 3 5 | 2 6 | 1 6 | 0 6 |
| 190 | 10 8 | 9 8 | 8 8 | 7 8 | 6 8 | 5 9 | 4 9 | 3 9 | 3 0 | 2 0 | 1 0 |
| 195 | 11 2 | 10 2 | 9 2 | 8 2 | 7 2 | 6 2 | 5 3 | 4 3 | 3 3 | 2 4 | 1 4 |
| 200 | 11 5 | 10 5 | 9 6 | 8 6 | 7 6 | 6 7 | 5 7 | 4 7 | 3 7 | 2 7 | 1 8 |

In comparing these two methods, Krogh stated that while the Harris Benedict prediction tables are reliable when average subjects are con cerned, they are less so for those of exceptional build or advanced years and that when used for exceptional subjects the Du Bois method is less likely to fail Berkson and Boothby,[9] from their critical studies of an exceptionally large number of patients at the Mayo Clinic concluded that the surface area method of Du Bois is to be preferred They state that all the observations they have examined support the hypothesis that when other factors are equal, the normal metabolism is proportional to the surface area as measured by the formula of Du Bois

In clinical practice any of these three standards will suffice for the ap praisal of normality of determinations on patients if one keeps in mind that healthy subjects may vary within approximately +5 to —20 per cent of the given standard It is apparent that they give an overestimate of the fuel requirement for maintenance of the basal state

*The probability of normal in a given case* can now be reduced to figures From their material Boothby and his associates[3] have constructed a nomogram (Fig 3) by means of which it is possible to determine the percentage of normal persons whose metabolic rate is greater and the percentage whose rate is less than that of the person under consideration

The foregoing statements concerning the basal metabolic rate refer to the ordinary, fairly well nourished person about fourteen hours after a meal and the figures given do not apply during prolonged starvation in states of marked *inanition, in fevers or certain other diseases* It is a fact of great importance to the clinician that partial inanition reduces heat production as much as does complete starvation, this reduction may be as great as 30 per cent Lusk,[10] in an excellent review of this subject suggested that there is a biologic adaptation to lowered energy intake Examples of this are cited by Mitchell [11] who believes that this condition ing factor of adaptation accounts for the survival of the peoples of war torn Europe with their extremely restricted food supply

The Minnesota Experiment[12] has confirmed the *occurrence of* a de crease in metabolism during semistarvation, regardless of whether the

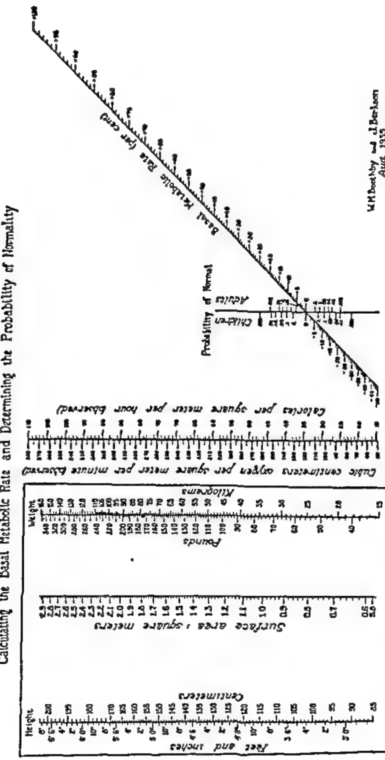


Fig. 3. Nomogram for use in computing the basal metabolic rate and determining the probability of normality. (Boothby and Berkson)

metabolic rate was calculated on a basis of surface area or body weight It was concluded that a portion of this decrease represented an adaptation

**The Increment of the Specific Dynamic Action (SDA) of Food** Since the mere ingestion and assimilation of food, notably of protein, increase the metabolic rate, the estimated amount of this increase must be added to the total metabolism The extent to which this specific dynamic action is felt depends on the amount and kind of food eaten This is illustrated in Table 10 by the figures given by Du Bois [6]

As noted previously, it is widely held that the SDA is an additive function, but recent studies lead to a questioning of the concept of the additive quality of these values for individual foodstuffs The data on SDA of high protein and of high-carbohydrate meals studied recently in Mitchell s laboratory cannot be accounted for on the basis of additive factors These data[13] show that the consumption of high protein (37 per cent) or low protein (7 per cent) high carbohydrate diets in 1000 Calorie amounts resulted respectively in an increased caloric production of 17 0 and of 9 6 per cent of the calories eaten The SDA followed a curve of diminishing returns but was detectable at twelve to sixteen hours The maximum SDA of 33 0 Calories per hour and of 21 0 Calories per hour was obtained at two and one and a half hours postprandially respect ively, for the high protein and high carbohydrate diets The total SDA amounted to 169 Calories for the high protein and 103 Calories for the high carbohydrate diet It is apparent that this effect makes an appre ciable addition to the caloric requirement but that the difference be tween high and low protein meals is less than is usually assumed and that this difference of but a few Calories per hour (maximum difference 12 Calories per hour) does not make a significant contribution to the ability to withstand cold Furthermore it does not endow a high protein diet with any significantly superior value for reduction in weight of obese patients

In the calculation of fuel requirements the physician will not go far astray if he adds to the physiologic basal metabolism some 10 per cent to cover the cost of the specific dynamic action of ingested food As a practical point the standards for basal metabolism[2, 3] as usually used clin ically are higher than physiologic basal metabolism by some 5 to 8 per cent In addition metabolism during sleep is lowered by approximately 10 per cent Hence the standards of basal metabolism as usually stated are at such a level to cover the physiologic basal metabolism plus the SDA of ingested food

**The Increment of Exercise and Work** In estimating a person s fuel requirements there must be added to the number of Calories necessary for basal metabolism a sufficient number of Calories to take care of his ordinary activities and of any physical labor in which he is engaged Mental work can be ignored for Bills[14] concluded that a metabolic in crease of only 3 or 4 per cent from such work is probably a fair estimate Physical work however, causes a material increase in fuel requirement For instance sitting in a chair or the mere act of standing materially increases the metabolic rate this increase has been estimated as 10 per cent of the basal figure The act of getting out of bed and dressing is

**Table 6 Calorie Requirements (Orr and Leitch)**

Calorie Requirements for Various Activities To Be Added to B M. R +10 Per Cent for S D A

Domestic and Artistic Occupations

| | | Calories per Hour | | | Calories per Hour |
|---|---|---|---|---|---|
| Kestner | Sewing | 10-20 | Kestner and Knipping | Writing | 20 |
| | Writing | 10-20 | | Sewing | 25-30 |
| | Sweeping | 110 | | Polishing | 174 |
| | Dusting | 110 | | Washing | 130 |
| Rose* (Sherman) | Sitting at rest | 15 | | Drawing (standing) | 40-50 |
| | Reading aloud | 20 | | Declaiming (without gesture) | 85 |
| | Standing relaxed | 20 | | Singing | 11-56 |
| | Sewing | 26 | | Reading aloud | 23-37 |
| | Knitting | 31 | | *Violin playing* | 46 |
| | Dressing and undressing | 33 | | Cello playing | 50-70 |
| | Singing | 37 | | Piano playing | 40-560 |
| | Ironing (with 5 pound iron) | 59 | | Trumpet playing | 16-59 |
| | Dish washing | 59 | | Conducting | 44-95 |
| | Sweeping bare floor | 84 | | | |

* Derived by deducting from figure quoted the value for "Awake lying still' = 77 Calories + 10 per cent = 85 Calories.

Industrial Occupations

| | | Calories per Hour | | | Calories per Hour |
|---|---|---|---|---|---|
| Kestner | Mental work | 7-8 | Maisels et al | Coal mining cutting | 114 |
| | Writing | 10-20 | | Hewing | 103-138 |
| | Carpenter | 180 | | Timbering | 205 |
| | Stone mason | 330 | | | |
| | Sawing wood | 420 | Kestner and Knipping | Writing | 20 |
| | | | | Typing | 16-40 |
| Rose* (Sherman) | Tailoring | 50 | | Sewing | 31-88 |
| | Typewriting rapidly | 55 | | Lithographer | 40-50 |
| | Bookbinding | 85 | | Bookbinding (light) | 43 71 |
| | Shoemaking | 95 | | Bookbinding (partly heavy) | 90 |
| | Carpentry, metal working industrial painting | 155 | | Shoemaking | 80-115 |
| | | | | Housepainting | 160 |
| | Stone working | 315 | | Joiner | 137-176 |
| | Sawing wood | 395 | | Laundry washing | 230 |
| Farkas and Geldrich† | Tailoring | 75-84 | Becker and Hamäl ainen (R S Comm ) | Tailor | 44 |
| | Shoemaking | 82 | | Bookbinder | 81 |
| | Locksmith (light work) | 117 | | Shoemaker | 90 |
| | Joiner (medium work) | 195 | | Metal worker | 141 |
| | Cartwright (medium work) | 196 | | Painter | 145 |
| | Cartwright (fairly heavy) | 229 | | Carpenter | 140 |
| | Smith (light work) | 276 | | Stonemason | 303 |
| | Smith (heavy work) | 351 | | Wood cutter | 388 |
| | | | | Women Seamstress | 6 |
| Frois (M R C ) | Riveting | 276 | | Streamstress (machine) | 24-57 |
| | | | | Laundress | 124-214 |
| | | | | Charwoman | 81-157 |
| Moss | Coal mining (av for shift) | 320 | | Bookbinder | 51 |

* Derived by deducting from figure quoted the value for 'Awake lying still = 77 Calories + 10 per cent = 85 Calories.

† Increase over B M R less 7 Calories for S D A

Table 6 (Continued)

Physical Exercise

| | | Calories per Hour | | | Calories per Hour |
|---|---|---|---|---|---|
| Kestner | Walking | 150–240 | Cathcart and Orr | Drill without arms | 83 |
| | Marching | 280–400 | | Marching drill order | 245 |
| | Running | 800–1000 | | Route march | 384 |
| | Cycling | 180–600 | | | |
| | Rowing | 200–900 | Hill (Brody) | Rowing | 1240 |
| | Swimming | 300–700 | | Running | 1242 |
| | Climbing | 400–900 | | | |
| Rose* (Sherman) | "Light exercise | 85 | | | |
| | Walking slowly (2.6 miles per hour) | 115 | Kestner and | Standing (stuffy) | 20–30 |
| | | | | Walking | 130–200 |
| | "Active exercise | 205 | | | |
| | Walking moderately fast (3.75 miles per hour) | 215 | | | |
| | "Severe exercise | 365 | | | |
| | Swimming | 415 | | | |
| | Running (5.3 miles per hour) | 485 | | | |
| | "Very severe exercise | 515 | | | |
| | Walking very fast (5.3 miles per hour) | 565 | | | |
| | | | | Fencing | 530–585 |
| Cathcart and Orr | Standing at ease | 23 | | | |
| | Sitting at lectures | 13 | | | |
| | Standing at attention | 16 | | | |

* Derived by deducting from figure quoted the value for "Awake lying still" = 77 Calories + 10 per cent = 85 Calories

estimated as adding about 150 Calories. Walking along a level road at the rate of 3 miles an hour (the maximum of economic velocity) necessitates a metabolic increase of 1.1 Calories an hour for each pound of body moved. This applies to extra weight carried in the same measure as it applies to body weight.

In a comprehensive review of man's energy requirements Orr and Leitch[15] assembled the figures given by various investigators and constructed the tables which are reproduced here as Tables 6 to 9.

**Influence of Temperature on Fuel Requirements.** Fuel requirements may be affected by environmental temperature through the alteration of basal metabolism or by changes in heat production necessary for maintaining the body temperature. This latter effect is minimized by comfortable dress. In addition, the environmental temperature may indirectly alter the energy expended in spontaneous physical activity. These and other effects are logically in the direction of a decreased energy expenditure in warm climates and an increased fuel consumption in cold regions. The voluntary caloric intakes of similar personnel do, indeed, reflect these alterations as reported by Johnson and Kark.[16] For example, the average caloric consumption for military personnel approximated 5000 in an arctic region with a mean temperature of —20° F., while it was approximately 3500 where the mean temperature was +70° F. The

Table 6 (Continued)

Supplements for Muscular Activity

L o N T C [League of Nations Technical Committee] Allowances Compared with Calorimetric Estimates

| | Calories per Hour of Work | | | |
|---|---|---|---|---|
| | Light Work up to 75 | Moderate Work, 75–150 | Hard Work, 150–300 | Very Hard Work 300 and Over |
| Women Household | Writing | Sweeping | Polishing | |
| | Sewing | Dusting | | |
| | Knitting | Washing | | |
| | Ironing | | | |
| | Dishwashing | | | |
| Industrial | Typing | Laundress 124 | 214 | |
| | Bookbinding | Charwoman 81 | 157 | |
| Artistic | Reading aloud | | | |
| | Drawing | | | |
| | Singing | | | |
| | Playing violin etc | | | |
| | Playing piano 40 | | | 560 |
| | Conducting 44 | 95 | | |
| Men Industrial | Tailor 44 | 84 | Cartwright | |
| | Lithographer | | Riveter | |
| | Bookbinder 43 | 90 | Smith 276 | 351 |
| | | Shoemaker | | Coal miner |
| | | Locksmith | | Stone mason |
| | | Joiner 137 | 155 | Wood cutter |
| | | Carpenter 140 | 180 | |
| | | Painter 145 | 160 | |
| | | Metal worker 141 | 155 | |
| Exercise | | Light exercise | Active exercise | Severe exercise |
| | | Drill without arms | Walking | Walking fast |
| | | Walking slowly | Marching | Running |
| | | | Rowing 200 | 1240 |
| | | | Cycling 180 | 600 |
| | | | Swimming 200 | 700 |
| | | | Climbing 200 | 960 |
| | | | | Wrestling |
| | | | | Fencing etc |

implications of such findings are obvious for the comparative requirements of persons inhabiting the comfortably heated homes and shops of today and those who lived a less sheltered life of earlier years

**Growth** Within the normal cell constantly occurring syntheses and degradations result in the dynamic interchange of tissue constituents the body pool of nutrients and the substances derived from the diet Whenever there is a net increase in tissue substance, the process may be termed "growth" The tissues laid down during growth represent an increased energy requirement It is difficult to estimate the magnitude of this requirement, and it is best measured by a knowledge of changes in tissue composition For infants Jeans[17] has estimated the energy requirement for growth at 15 to 20 Calories per day per kilogram of body weight

**Table 7 Estimated Total Daily Energy Expenditure of Men (Orr and Leitch)**

| | Average | | | Minimum | | |
|---|---|---|---|---|---|---|
| | | Calories | | | Calories | |
| Unemployed man | 24 hours basal + 10 per cent for S D A | | 1630 | 24 hours basal + 10 per cent for S D A | | 1630 |
| | 1 hour dressing and undressing | 33 | | 1 hour dressing and undressing | 33 | |
| | 5 hours sitting | 75 | | 7 hours sitting | 105 | |
| | 2 hours walking slowly | 230 | | 2 hours walking slowly | 230 | |
| | 3 hours gardening | 320 | | 4 hours standing | 80 | |
| | 3 hours standing | 60 | | | | |
| | | | | | 448 | |
| | | 718 | | | | |
| | Corrected* | | 660 | Corrected | | 410 |
| | | Total | 2290 | | Total | 2040 |
| Employed men 1 Tailor | 24 hours basal + 10 per cent for S D A | | 1694 | As before | | 1694 |
| | 8 hours tailoring at 80 per hour | 640 | | | | |
| | Corrected | | 611 | As before | | 611 |
| | 1 hour dressing and undressing | 33 | | As before | 33 | |
| | 1 hour walking slowly | 115 | | As before | 115 | |
| | 4 hours sitting | 60 | | 3 hours sitting | 45 | |
| | 2 hours light exercise | 170 | | 3 hours standing | 60 | |
| | | 378 | | | 253 | |
| | Corrected | | 361 | Corrected | | 242 |
| | | Total | 2666 | | Total | 2547 |
| 2 Locksmith | As above | | 1694 | As before | | 1694 |
| | 8 hours work at 117 | 936 | | | | |
| | Corrected | | 893 | As before | | 893 |
| | 8 hours activity as above | | 361 | As above | | 242 |
| | | Total | 2948 | | | 2829 |
| 3 Carpenter or Painter | As above | | 1694 | As before | | 1694 |
| | 8 hours work at 150 | 1240 | | | | |
| | Corrected | | 1184 | As before | | 1184 |
| | 8 hours activity as above | | 361 | As above | | 242 |
| | | Total | 3239 | | Total | 3120 |
| 4 Joiner | As above | | 1694 | As before | | 1694 |
| | 8 hours medium work at 195 | 1560 | | | | |
| | Corrected | | 1490 | As before | | 1490 |
| | 8 hours activity as above | | 361 | As above | | 242 |
| | | Total | 3545 | | | 3426 |
| 5 Smith | As above | | 1694 | As before | | 1694 |
| | 8 hours heavy work at 350 | 2800 | | | | |
| | Corrected | | 2674 | As before | | 2674 |
| | 8 hours activity as above | | 361 | As above | | 242 |
| | | Total | 4729 | | Total | 4610 |

* Corrected from "mean man" to surface areas as given in Table 9 Factor for unemployed 0.92 employed 0.955 black coated worker 0.983

Note —The substitution for light exercise of any form of athletic activity or physical training will (allowing 2 hours) increase the estimated expenditure by from 300 to over 100 Calories

Table 7 (Continued)

| | Average | Calories | | Minimum | Calories |
|---|---|---|---|---|---|
| 6 Clerk | 24 hours basal + 10 per cent for S D A | | 1738 | As before | 1738 |
| | 8 hours work as | | | | |
| | 2 hours mental work | 16 | | | |
| | 4 hours writing | 60 | | | |
| | 2 hours typing | 110 | | | |
| | | 186 | | | |
| | Corrected | | 183 | As before | 183 |
| | 1 hour dressing and undressing | 33 | | | |
| | ½ hour walking slowly | 58 | | | |
| | 3 hours golf† | 645 | | | |
| | 3½ hours sitting | 52 | | | |
| | | 788 | | | |
| | Corrected | | 775 | As above | 249 |
| | | Total | 2696 | | Total 2170 |

† The estimate for golf is based on the statement of a golfer that he rates the exertion with moderately fast walking

Table 8 Estimated Total Daily Energy Expenditure of Women (Orr and Leitch)

| Housewife | Calories | | Typist | Calories | |
|---|---|---|---|---|---|
| 24 hours of basal + 10 per cent for S D A | 1452 | | 24 hours of basal + 10 per cent for S D A | 1452 | |
| 8 hours housework at an average of 70 Calories per hour | 560 | | 8 hours typing at 30 Calories per hour | 240 | |
| 1 hour walking | 100 | | 3 hours light exercise at 80 Calories per hour *or* | 240 | |
| 7 hours at 30 per cent of basal | 115 | | 2 hours l ght exercise at 80 and 1 hour more vigorous exercise at 200 | | 360 |
| | 2227 | | 5 hours at 60 per cent of basal | 165 | |
| Corrected* | 2100 | | | 2097 or 2217 | |
| Bookbinder | | | Corrected | 1977 or 2091 | |
| 24 hours basal + S D A | 1452 | | Charwoman | | |
| 8 hours work at 50 | 400 | | 24 hours basal + S D A | 1452 | |
| 1 hour walking *or* | 100 | | 8 hours work at from 81 to 157 Calories per hour | 648 to 1256 | |
| 3 hours light exercise | | 240 | 1 hour walking | 100 | |
| 7 hours at 30 per cent of basal *or* | 115 | | 7 hours at 30 per cent of basal | 115 | |
| 5 hours at 60 per cent of basal | | 165 | | 2315 to 2923 | |
| | 2067 or 2257 | | Corrected | 2183 to 2756 | |
| Corrected | 1949 or 2128 | | | | |
| Laundress | | | | | |
| 24 hours basal + S D A | 1452 | | | | |
| | 3107 to 3379 | | | | |
| Corrected | 2930 to 3186 | | | | |

* Surface area for factory women 1 48 sq m correction factor 0 943

**Table 9 The Recruit's Day Cost to Individuals of Different Stature (Orr and Leitch)**

| | [illegible] | [illegible] | [illegible] Sq M | B M R [illegible] per Sq M per Hour | [illegible] S D A | Energy Expenditure [illegible] and Orr, Calories | Energy Expenditure on Day's Activities Allowing for S D A as 10 per cent of B M R, Calories |
|---|---|---|---|---|---|---|---|
| Recruits from studies by Cathcart and Orr | 171 0 | 59 8 | 1 70 | 1 542 | 1,696 | 3 432 | 1,736 |
| Infantry minimum | 162 6 | 52 2 | 1 54 | 1,400 | 1,540 | 3,100 | 1,560 |
| Unemployed | 166 7 | 57 85 | 1 63 | 1 480 | 1,630 | 3 300 | 1 670 |
| Employed | 169 0 | 61 25 | 1 69 | 1,540 | 1,694 | 3 400 | 1,700 |
| 'Black-coated' workers | 172 3 | 63 69 | 1 74 | 1 580 | 1,738 | 3 500 | 1,760 |
| University students | 174 3 | 62 82 | 1 74 | 1,580 | 1,738 | 3 500 | 1,760 |
| Public school youths (18 years) | 180 5 | 70 65 | 1 88 | 1 700 | 1,870 | 3 800 | 1,930 |

**Table 10 Summary of Calorimeter Experiments of Effect of Mixed Diet in Increasing Heat Production (Du Bois[5])**

| Subject | Meals | Fuel Value, Cal | Total N Gm | Calories, per cent: Protein | Calories, per cent: Fat | Calories, per cent: Carbohydrate | Estimated Increase in Heat Calories* | Cost of Digestion, Heat Increase Divided by Fuel Value |
|---|---|---|---|---|---|---|---|---|
| | SAGE CALORIMETER | | | | | | | |
| | Body wt | | | | | | | |
| E F D B | Small breakfast, 73 9 kg | 222 | 0 8 | 9 | 39 | 52 | 5 4 | 2 4 |
| D P B | Small breakfast, 65 2 kg | 222 | 0 8 | 9 | 39 | 52 | 5 4 | 2 4 |
| L O R | Small breakfast 45 8 kg | 222 | 0 8 | 9 | 39 | 52 | 13 2 | 5 9 |
| Louis M | Meat and butter | 1564 | 23 9 | 41 | 59 | 0 | 99 4 | 6 3 |
| | CHAIR CALORIMETER NUTRITION LABORATORY | | | | | | | |
| H L H | Moderate supper | 1731 | 7 3 | 11 | 21 | 68 | 84 0* | 4 9 |
| A L L | Heavy breakfast | 2720 | 10 9 | 10 | 52 | 38 | 198 0* | 7 3 |
| A L L | Heavy breakfast | 2142 | 8 0 | 9 | 47 | 44 | 111 0* | 5 2 |
| A H M | Heavy breakfast | 4378 | 19 5 | 12 | 56 | 32 | 225 0* | 5 0 |
| A H M | Heavy breakfast | 3936 | 20 1 | 13 | 54 | 33 | 290 0* | 7 4 |
| H R D | Heavy breakfast | 3311 | 14 6 | 12 | 43 | 45 | 226 0* | 6 8 |
| H R D | Heavy breakfast | 3697 | 17 1 | 12 | 54 | 34 | 193 0* | 5 2 |
| | UNIT RESPIRATION APPARATUS NUTRITION LABORATORY | | | | | | | |
| J J C | Moderate breakfast | 796 | 3 4 | 11 | 26 | 63 | 45 0 | 6 0 |
| A F | Small breakfast | 468 | 3 0 | 17 | 52 | 31 | 19 0 | 4 0 |

* Increase actually found plus increase estimated for periods between ingestion of food and start of experiment and for period of one to three hours after some of the experiments

From Du Bois Basal Metabolism in Health and Disease 3d ed Philadelphia, Lea & Febiger, 1936

Table 11 Total Energy Requirement Every Twenty four Hours Including Eight Hours of Labor as Estimated by Becker and Hämäläinen

| Men | Calories |
|---|---|
| Tailors | 2600–2800 |
| Bookbinders | 3000 |
| Shoemakers | 3100 |
| Metal Workers | 3100–3500 |
| Painters | 3500–3600 |
| Cabinet makers | 3500–3600 |
| Stone masons | 4100–5200 |
| Wood sawers | 5500–6000 |
| Women | |
| Seamstress (with hand needle) | 2000 |
| Seamstress (with machine) | 2100–2300 |
| Bookbinder | 2100–2300 |
| Household servants | 2500–3?00 |
| Washerwomen | 2900–3700 |

Any process which results in new tissue formation may be termed growth From this viewpoint growth embraces the processes of pregnancy lactation convalescence with tissue gain and repair of injured tissues One cannot specify the actual calories required to allow for all types of growth This subject will be further discussed in later chapters of the book

**Metabolism of Children** The statement made at the beginning of this chapter concerning the accuracy of metabolic prediction does not apply to the active child no one has yet been able to measure accurately the enormous amount of energy put forth by a child especially of an active boy! Not only is his basal metabolic rate proportionately higher (about 25 per cent) but he burns up an enormous amount of fuel through his almost incessant muscular activity The same to a less extent can be said of a girl The total metabolism of a boy of twelve or fourteen years often exceeds that of his father Gephart's[18] observation of the food consumption of boys at a private boarding school showed that their intake frequently reached 5000 Calories Benedict and Talbot[24] in their studies of the metabolism of growing children stated The activities are it is true enormous The food consumption is proportionately great Figure 4 represents Lusk's estimate of the metabolism of boys of varying degrees of activity

**Simpler Methods for Determining Caloric Requirement** The methods and formulas that have been given for evaluating separately many of the factors which influence a person's metabolism and for predicting with a high degree of precision his fuel requirements are for the majority of persons unnecessarily elaborate In diabetes mellitus less often in nephritis or obesity and rarely in other diseases such methods are applicable Shorter methods will ordinarily suffice Such accuracy in the prescription of the food presupposes similar accuracy in its preparation and consumption a condition which it is difficult to secure except with the aid of a specially equipped diet kitchen Even the best of hospital kitchens when not connected with a metabolism ward are not prepared for such precision Aside from the question of unnecessary labor it is important not to make a show of precision which circumstances do not warrant

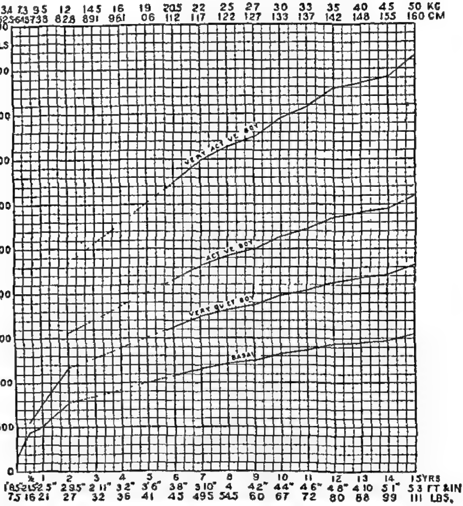


Fig 1 Metabolism in calories per day of boys from birth to fifteen years of age (Lusk[20])

In those diseases in which accuracy of metabolic control is required it usually suffices to estimate the patient s twenty four hour basal metab olism by means of the Du Bois surface area chart or the Harris Benedict prediction formula and to add thereto a figure which is an approximately correct measure of the other factors which influence his metabolism Under other circumstances it often suffices to determine from tables al ready prepared that a clerical worker for example may consume 2700 Calories or a carpenter 3500 Calories and to adopt the appropriate fig ures For such estimates of the total fuel requirements of persons en gaged in various occupations the figures of Becker and Hamalainen[1] although high are widely accepted (Table 11) These figures however are overestimates of needs[23] As one reviewer[20] puts it Any such stand ard is to be considered merely as an indication of the general magnitude of the caloric needs of a person and not as an expression of a fixed requirement '

More modern but also generous caloric allowances for individuals are the *recommended daily allowances of the Food and Nutrition Board* of the National Research Council[21] These are detailed in the Appendix

**Table 12 Calorie Requirements of Adult Population Groups According to Body Size. Mean Temperature = 10° C. FAO Estimate [22]**

| Weight | Men | Women | Pregnant Women | Lactating Women |
|---|---|---|---|---|
| (kg) | ( | Calories per day | | ) |
| 40 | | 1823 | 2273 | 2823 |
| 45 | 2447 | 1987 | 2437 | 2987 |
| 50 | 2643 | 2146 | 2596 | 3146 |
| 55 | 2833 | 2300 | 2750 | 3300 |
| 60 | 3019 | 2451 | 2901 | 3451 |
| 65 | 3200 | 2599 | 3049 | 2599 |
| 70 | 3379 | 2743 | 3193 | 3743 |
| 75 | 3553 | | | |
| 80 | 3725 | | | |

**Table 13 Calorie Requirements of Adult Population Groups According to Age. Mean Temperature = 10° C. FAO Estimate [22]**

| Age | Men | Women | Pregnant Women | Lactating Women |
|---|---|---|---|---|
| (Years) | ( | Calories per day | | ) |
| 20 30 | 3200 | 2300 | 2750 | 3300 |
| 30–40 | 2960 | 2128 | 2578 | 3127 |
| 40 50 | 2720 | 1955 | 2405 | 2955 |
| 50–60 | 2480 | 1782 | | |
| 60 70 | 2240 | 1610 | | |
| 70–80 | 2000 | 1438 | | |
| 80 90 | 1760 | 1265 | | |
| 90 100 | 1520 | 1093 | | |

**Table 14 Calorie Requirements of Adult Population Groups According to Environmental Temperature FAO Estimate [22]**

| Mean External Annual Temperature | Men | Women | Pregnant Women | Lactating Women |
|---|---|---|---|---|
| (Degrees C) | ( | Calories per day | | ) |
| −5 | 3440 | 2473 | 2923 | 3473 |
| 0 | 3360 | 2415 | 2865 | 3415 |
| 5 | 3280 | 2358 | 2808 | 3358 |
| 10 | 3200 | 2300 | 2750 | 3300 |
| 15 | 3120 | 2243 | 2693 | 3243 |
| 20 | 3040 | 2185 | 2635 | 3185 |
| 30 | 2880 | 2070 | 2520 | 3070 |

In a recent report[22] the Committee on Caloric Requirements of the Food and Agriculture Organization of the United Nations has recommended a method of estimating the *requirement of population groups* (not of individuals) This method makes use of the device of defining a standard reference man and woman and adjusting for deviations from the reference standard in age, body size environmental temperature, physiologic state, and so on Examples of the calculated estimates made by this method are tabulated in Tables 12 to 14

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# 4

## *The Protein Problem*

"Protein is man's chief source of nitrogen, and the rate of supply obviously conditions growth, maintenance, repair, reproduction and lactation. To subserve these processes is its primary function."[1] How much protein, then, does a person need? What is the smallest intake compatible with the assured preservation of health and vigor? These have been much discussed questions, and in order to answer them in the light of present day knowledge, three points must be considered: (*a*) the quality or biologic value of the protein consumed, (*b*) the definition of "adequate" as applied to protein intake, and (*c*) the criterion by which "health and vigor" are judged, whether by a sense of well-being, with the efficient accomplishment of work experienced during a limited period, by the preservation of youthful vigor with comparative freedom from disease during an appreciably large fraction of the person's life or by other criteria.

**Amino Acids.** No two proteins are exactly alike, and because of differences in structure they vary widely in nutritive value. Proteins consist of chains or groups of amino acids linked together, and the kind and number of these component amino acids, many of them *indispensable*, determine nutritive values. Indispensable amino acids may be defined as those amino acids which cannot be synthesized by the organism from ordinarily available materials at a rate sufficient to meet the demands of a given physiologic process. The physiologic processes which have been used most often as criteria of indispensability include growth,[2] maintenance of nitrogen balance,[3] hemoglobin and plasma protein synthesis, and tissue synthesis during repletion of protein-deficient animals.[16] Studies have been made on a variety of laboratory animals, and it is now apparent that the same requirement does not apply to all ages and species alike. Certain amino acids needed for growth of young rats are apparently not required for maintenance of adults of the same species or for human beings. Histidine, for example, although essential for the growth of young rats, is not needed by man.[2] This question of indispensability is complicated still further by the fact that certain animals, notably young rats, are able by means of the bacteria in their intestines to synthesize some of their amino acids, but lose this property when bacterial action is inhibited by chemical substances such as succinylsulfathiazole. Table 15 summarizes the classification of amino acids for some spe-

**Table 15 Amino Acids Classified as Essential for Different Species by Varying Criteria**

| | Rat | | Chick | Dog | Man |
|---|---|---|---|---|---|
| | Growth[2] | Nitrogen[3] Balance | Growth[4,5] | Nitrogen[6] Balance | Nitrogen[7] Balance |
| Lysine | + | − | + | + | + |
| Tryptophan | + | + | + | + | + |
| Histidine | + | − | + | + | − |
| Phenylalanine | + | −†† | +††† | + | + |
| Tyrosine (hydroxyphenylalanine) | − | +†† | −††† | − | − |
| Leucine | + | − | + | + | + |
| Isoleucine | + | + | + | + | + |
| Threonine | + | + | + | + | + |
| Methionine | +† | +** | +† | + | + |
| Valine | + | + | + | + | + |
| Arginine | +* | − | + | − | − |
| Glycine | − | − | +* | − | − |
| Alanine | − | − | − | − | − |
| Serine | − | − | − | − | − |
| Norleucine | − | + | − | − | |
| Aspartic acid | − | − | − | − | − |
| Glutamic acid | − | − | − | − | − |
| Hydroxyglutamic acid | − | − | − | − | |
| Proline | − | − | − | − | − |
| Hydroxyproline | − | − | − | − | − |
| Citrulline | − | − | − | − | − |
| Cystine | −† | +** | −† | − | − |

* Can be synthesized, but not at a rate to meet demands of *normal* growth
† Cystine can replace part of the requirement for methionine
** Cystine requirement can be replaced by methionine, but methionine requirement cannot be met by cystine alone
†† Either tyrosine or phenylalanine will meet maintenance requirement of the rat
††† Tyrosine exerts a phenylalanine sparing effect

**Table 16 Comparison of Tentative Minimum and Recommended Intakes of Essential Amino Acids (Rose[7]) and the Calculated Average Quantity of Amino Acids Consumed Daily (Block and Bolling[15]) During the Spring of 1942**

| Amino Acid | Minimum Daily Requirement | Recommended Daily Intake | Intake Poorest Urban Class (Income $0–499) | Intake Urbane Middle Class (Income $2500–$2999) | Intake, Poorest Farm Class (Income $0–499) | Intake, Farm Middle Class (Income $1000–$1499) |
|---|---|---|---|---|---|---|
| | gm | gm | gm | gm | gm | gm |
| L-Tryptophan | 0 25 | 0 5 | 0 91 | 1 23 | 1 11 | 1 21 |
| L Phenylalanine | 1 10 | 2 2 | 4 05 | 5 07 | 5 00 | 5 18 |
| L Lysine | 0 80 | 1 6 | 4 00 | 5 82 | 4 74 | 5 49 |
| L-Threonine | 0 50 | 1 0 | 2 81 | 3 89 | 3 37 | 3 66 |
| L Valine | 0 80 | 1 6 | 4 17 | 5 57 | 5 27 | 5 64 |
| L Methionine | 1 10 | 2 2 | 2 98* | 4 03* | 3 62* | 3 93* |
| L-Leucine | 1 10 | 2 2 | 6 47 | 8 19 | 8 25 | 8 48 |
| L-Isoleucine | 0 70 | 1 4 | 4 20 | 5 69 | 5 27 | 5 68 |
| Total Protein | | | 74 0 | 94 0 | 90 0 | 95 0 |

* Methionine plus cystine

value of kidney, liver and muscle of the ox, McCollum and his co-workers[13] found that the kidney is superior to the others, with the liver second and muscle meats third.

Of distinctly lower biologic value are the plant proteins, such as those of wheat, corn, oat, rice, peas and beans. Among these, wheat ranks highest. It appears that each of these seeds contains all the necessary amino acids, but that in each of them one or more of these building stones are present in such inadequate amounts as to render the entire protein of low value. Just as a chain is as strong as its weakest link, so is a protein as valuable as the building stone which it provides in smallest amount. When taken alone as the sole source of protein, none of these grains will maintain maximum health and vigor. They must be supplemented by proteins from a different source.

This supplementary value of a protein is of great importance. A given protein, because of its failure to supply one or more building stones properly, may be of low biologic value; but it may still be useful as a food, because when it is supplemented by another protein which provides the missing amino acids, the mixture of the two will be of high biologic value. Proteins from similar sources, such as two grains, may not supplement each other satisfactorily, but foodstuffs from different sources may supplement each other well. Thus, a good supplementary relationship has been found occasionally between a grain and a legume seed, notably between wheat and peas; a mixture of corn and peas is not so valuable. Meat proteins enhance the value of the grains in the most satisfactory manner; milk runs a close second.

Before consideration can be given to the amount of protein needed by man, there must be full appreciation of the importance of biologic values and of the supplementary properties which the various proteins exhibit toward one another. To reach the highest degree of physiologic economy, it is essential that those proteins of the diet which are of low biologic value, such as those of grains, be supplemented by proteins of high biologic value and of good supplementary worth, such as are found in meat or milk. It is a fortunate circumstance, therefore, that the average diet contains proteins from many different sources.

*Table 17 summarizes nutritional values for protein in several common* foods. These values may be compared with the essential amino acid content of similar foods as shown in Table 18. It is apparent that foods of high biologic values supply a generous complement of the essential amino acids. Some calculations of the amino acid intake of different population groups are reproduced in Table 16 for comparison with the estimated requirements. It is apparent that deficiencies of specific amino acids are unlikely to be encountered at these levels of intake from existing sources of protein. The dietary sources of the essential amino acids have been tabulated by Block and Bolling.[15] In general, 20 to 30 per cent of the essential amino acids in the average dietary are derived from milk, cheese and ice cream; 15 to 35 per cent from meat, poultry and fish; 15 to 30 per cent from grain products; 6 to 10 per cent from eggs; and less than 10 per cent from each class, "beans and nuts" and "potatoes, vegetables and fruits."

**Table 17. Protein Values of Foods for Maintenance and Growth: Level of Protein Feeding, 8 to 10 Per Cent (Mitchell and Hamilton[14])**

| Food | Water Content* | Protein Content*: On Fresh Basis | Protein Content*: On Dry Basis | Quality of Protein: Digestibility (Corr.) | Quality of Protein: Biological Value | Metabolic Protein in Feces†: On Fresh Food Basis | Metabolic Protein in Feces†: On Dry Food Basis | Protein Value of Food: On Fresh Basis | Protein Value of Food: On Dry Basis |
|---|---|---|---|---|---|---|---|---|---|
| | % | % | % | % | % | % | % | % | % |
| Whole egg‡ | 73.2 | 13.2 | 49.3 | 100 | 94 | 0.4 | 1.4 | 12.0 | 44.9 |
| Milk | 87.0 | 3.3 | 25.4 | 100 | 85 | 0.2 | 1.4 | 2.6 | 20.2 |
| Egg white‡ | 86.2 | 12.3 | 89.1 | 100 | 83 | 0.2 | 1.4 | 10.0 | 72.6 |
| Beef liver | 71.2 | 20.4 | 70.8 | 90 | 77 | 0.4 | 1.4 | 14.9 | 51.1 |
| Beef kidney | 76.7 | 16.6 | 71.3 | 99 | 77 | 0.3 | 1.4 | 12.3 | 52.8 |
| Beef heart | 62.6 | 16.0 | 42.8 | 100 | 74 | 0.5 | 1.4 | 11.3 | 30.3 |
| Beef round | 70.0 | 21.3 | 71.0 | 96 | 69 | 0.4 | 1.4 | 13.7 | 45.7 |
| Pork ham | 60.0 | 25.0 | 62.5 | 100 | 74 | 0.6 | 1.4 | 17.9 | 44.8 |
| Veal§ | 73.4 | 20.7 | 78.0 | 100 | 62 | 0.4 | 1.4 | 12.4 | 47.0 |
| *Rolled oats* | 7.7 | 16.7 | 18.1 | 90 | 65 | 1.3 | 1.4 | 9.8 | 10.6 |
| Whole wheat | 11.4 | 13.8 | 15.6 | 91 | 67 | 1.3 | 1.4 | 7.1 | 8.1 |
| White flour | 12.8 | 10.8 | 12.4 | 100 | 52 | 1.3 | 1.4 | 4.3 | 5.0 |
| Whole corn | 10.3 | 7.5 | 8.4 | 95 | 60 | 1.3 | 1.4 | 3.0 | 3.5 |
| Potato | 78.3 | 2.2 | 10.1 | 78 | 67 | 0.3 | 1.4 | 0.8 | 3.9 |
| *Navy beans*‡ | 12.6 | 22.5 | 25.7 | 76 | 38 | 1.3 | 1.4 | 4.2 | 6.0 |
| Cocoa | 4.6 | 21.6 | 22.6 | 38 | 37 | 1.4 | 1.4 | 1.6 | 1.8 |
| Chocolate | 5.9 | 12.9 | 13.7 | 38 | 37 | 1.4 | 1.4 | 0.4 | 0.6 |

* Average analyses taken, as far as possible, from Bull 28 (revised), Office of Experiment Stations U S Dept Agr

† The metabolic nitrogen in the feces is assumed to equal 0.23 gm per 100 gm of dry matter of food See Bull Natl Research Council, 1926, xi, pt 1, no 55, p 23

‡ Cooked

§ The cut tested was not recorded It proved to be very fibrous Analysis for shoulder cut assumed

This table is reproduced from Mitchell and Hamilton, The Biochemistry of the Amino Acids 1929 Reinhold Publishing Corp, N Y.

**Table 18 Approximate Essential Amino Acid Content of the Protein of Some Typical Foods* (Content Expressed as gm of Amino Acids per 100 gm of Total Protein Calculated on Basis of N x 6.25 = Total Protein)**

| | Whole Egg | Egg Albumin | Egg Yolk | Milk | Liver | Pork Fresh | Steak Cooked | Leg of Lamb: Fresh | Leg of Lamb: Cooked | Corn | Whole Wheat | Oats | White Potatoes | Peas and Beans |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total protein | 13 | 12 | 16 | 3.25 | 19 | 12.6 | 18.0 | 15.2 | 19.8 | 8 11 | 8 12 | 11-14 | 2 | 20 |
| *Tryptophan* | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.3 | 1.4 | 1.3 | 1.3 | 0.6 | 1.2 | 1.3 | 2.1 | 0.8 |
| Phenylalanine | 6.3 | 7.5 | 4.4 | 5.5 | 6.1 | 3.7 | 4.6 | 3.7 | 4.2 | 5.0 | 5.1 | 5.5 | 5.9 | 5.0 |
| Lysine | 7.0 | 6.5 | 5.7 | 8.7 | 7.0 | 8.0 | 7.9 | 7.7 | 7.9 | 2.3 | 2.7 | 3.6 | 8.3† | 6.5 |
| Threonine | 4.3 | 4.2 | 3.5 | 4.7 | 5.3 | 4.8 | 5.2 | 4.8 | 4.8 | 3.7 | 3.3 | 3.6 | 6.9† | 3.9 |
| Valine | 7.2 | 6.4 | | 7.0 | 6.0 | 4.8 | 5.0 | 4.7 | 4.9 | 5.3 | 4.3 | 5.4 | 5.3 | 5.5 |
| Methionine | 4.0 | 5.5 | 3.0 | 3.2 | 3.2 | 2.6 | 2.6 | 2.5 | 2.4 | 3.1 | 2.5 | 2.0 | 2.5 | 2.0 |
| (Cystine) | 2.4 | 2.4 | 1.9 | 1.0 | 1.4 | | | | | 1.5 | 1.8 | 1.8 | | 1.3 |
| Leucine | 9.2 | 9.4 | | 11.0 | 8.4 | 7.2 | 8.1 | 7.2 | 7.6 | 15.0 | 7.0 | 8.0 | 9.6† | 7.0 |
| Isoleucine | 7.7 | 7.5 | | 7.5 | 4.8 | 4.8 | 4.9 | 4.6 | 4.9 | 6.4 | 4.0 | 4.9 | 3.7 | 5.5 |
| (Arginine) | 6.6 | 6.1 | 7.2 | 4.2 | 6.6 | 5.9 | 6.5 | 6.8 | 7.2 | 4.8 | 4.3 | 6.8 | 5.0 | 7.0 |

* Adapted from Block and Bolling[15] Sweigert et al,[17] and Thomas[18]

† Values may be high

**Adequate Intakes** From the discussion of amino acids and biologic values it is readily apparent that the minimum requirement of protein varies with the composition of the total dietary protein and that a reasonable assortment of sources of protein within the diet insures an adequate supply of the essential amino acids Other influences, as yet incompletely defined, bear on the minimum requirement of protein For example, Rose[7] found that a higher caloric intake was necessary to maintain nitrogen balance in subjects ingesting a fixed quantity of protein hydrolysate or amino acid mixture than when they ate unhydrolysed protein (casein) Nitrogen retention (and, therefore, 'minimal protein requirement' as determined by the nitrogen balance method) is the result of the interaction of many influences Swanson[19] has enumerated some of these as caloric value of the diet, source of nonprotein calories, physiologic state, body stores, quantity of dietary protein, time factor and distribution of the protein over the day's meals Obviously, therefore, a practical diet should be designed to supply a reasonable margin of safety above the minimal protein intake which can suffice under ideal conditions How liberal should this allowance be?

An earlier belief, now perceptibly fading, in the harmfulness of high protein diets was based upon a fear of two modes of injury (1) absorption from the intestinal tract of poisonous products of protein decomposition, and (2) damage to the kidney when it is called upon to dispose of unnecessarily large amounts of nitrogenous end products The first of these, the fear of autointoxication, so called, is based largely upon vague clinical impressions The second of these fears cannot be disposed of so easily The possibility of damage to the arteries and kidneys from a high protein diet has been the subject of a vast amount of animal experiment, much of which is contradictory From these experiments there emerge two salient facts First, although renal damage has been produced in animals by dietary means the exaggeration in the rations used has been so great as to destroy their practical significance, second no single nutritive factor has been identified as producing a clinical picture resembling that of hypertensive nephritis in man

Turning more directly to man two questions present themselves Is a low protein diet compatible with continued health and the highest degree of development, and is such a diet therefore desirable? And does a high protein diet carry anything of advantage?

The 'low protein era" was introduced by Chittenden, who regarded the generally accepted protein allowances of Voigt (118 gm daily) and of Atwater (120 gm daily) as harmfully high This physiologist, as the result of personal experience as well as of observations upon groups of young men, concluded that sustained vigor and freedom from many minor physical ailments could be maintained with an intake of 40 to 50 gm of protein daily[20] A significant weakness in Chittenden's work was that there were no control groups upon whom could be measured the psychic and other disciplinary influences of the experiment It was faulty also in that the time element nine months or approximately 1 per cent of the subject's expectancy, was too short Furthermore, the diets were reasonably varied and did not permit faulty planning such as

might occur under practical feeding conditions. As discussed in Chapter 2, there is much evidence that nitrogen balance can be maintained in adults on intakes of about 40 gm. of protein daily. Accordingly, intake levels of 70 gm. per day for adults are reasonable.

There is much evidence for the ill effects of mild protein undernutrition. For example, McCollum, Simmonds and Parsons[13] found that young mice reared on a diet deficient only in respect to its protein content reached maturity and for a time maintained comparative health, but only for a time. On this diet the animals eventually showed lessened reproductive activity, lowered fertility, evidences of disease and early senility. Equally pertinent are the results of Slonaker and Card,[21] who found that pubescence, fertility and the menopause in mice were unfavorably influenced by a restricted diet and that the addition of animal protein to the ration materially lengthened the period of reproductive activity. Of similar import is the work of MacLeod,[22] who reported that feeding experiments with rats indicate that there is an improvement in reproduction and lactation when the fresh meat of the weekly mixed ration is increased from 10 to 40 gm.

In agreement with the animal investigations just cited are the observations of Benedict and his co-workers, who stated that the young men of their experiments found that a restricted diet definitely depressed sex instinct, even when it produced no other observable effect. They concluded that their data indicate that nature demands a rather high metabolic level for the normal functioning of sex in man. Other forms of impairment also have been noted.

On the other hand, since the time of Chittenden, instances have been reported of persons who have pursued vigorous, happy lives with a remarkably low intake of protein. Two such cases, that of Dr. C. Röse and that of another physician, were studied and reported by Strieck.[23] The first man lived for fifteen years with a daily protein intake of 38 to 40 gm. and enjoyed remarkable vigor; when almost seventy years of age he climbed mountains over 4000 meters high. The second, a younger man, for twenty-five months ate only about 30 to 40 gm. of protein and during this period, without signs of unusual fatigue or exhaustion, climbed twenty-two mountain peaks, including the Matterhorn. This author presents evidence demonstrating that a major hazard of such a marginal diet is that an intercurrent illness; even of mild degree, or some other disturbing circumstance, will make such additional demands upon the person's metabolism as to turn the scale and as a rule will bring about a negative balance. This may be disastrous. He compares these two examples with the cases of Stefansson and of Andersen, who upon the opposite type of diet, that excessively high in protein, maintained a like degree of vigor; and he concludes with the pertinent observation: "Both forms of diet are out of the question so far as actual practical use is concerned. Strong will power or a high degree of fanaticism are necessary in order to follow so one-sided a diet for a long period of time." The chief lesson to be drawn from these examples is that the human body has extraordinary powers of adaptability.

If, on the basis of the previously mentioned animal experiments, it is

assumed that an unusually low protein diet may in the course of time become harmful, and, conversely, that a liberal protein ration will confer increased health and vigor, will the latter type of diet when long continued produce harmful effect in man? The experience of the arctic explorer Stefansson, who for long periods totaling in all nine years of his stay in the Arctic Circle, subsisted solely on meat indicates that there are no such harmful effects Stefansson stated that while on this diet he experienced the highest degree of physical and mental well being enjoyed during his entire life To the explorer s testimony was added that of his physician, Lieb, who could see no ill effects of such a diet upon Stefansson or upon any of his men Of like tenor were the later reports of Tolstoi[24] and of McClellan and Du Bois[25] upon two healthy men, each of whom lived for a year upon an exclusive meat diet, the content of which was protein, 100 to 140 gm fat, from 200 to 300 gm, and carbohydrate (derived entirely from meat), 7 to 12 gm The fuel value was 2000 to 3100 Calories Beyond a diminution in the tolerance for carbohydrate, attributed to lack of the usual stimulus of dextrose there was no change in the blood or urine and renal function tests gave normal values The blood pressure of one man fell 20 mm, and that of the other remained constant There were no evidences of vitamin deficiency The subjects remained mentally alert and active McClellan and Du Bois wrote 'In these trained subjects, the clinical observations and laboratory studies gave no evidence that any ill effects had occurred from the prolonged use of the exclusive meat diet"

Does a liberal protein intake confer definite advantages? Much evidence could be cited in favor of an affirmative answer to this question Witness the relationship between phagocytic activity and the protein intake of young mice[26] and the importance of protein in the formation of antibodies [27] also the more rapid healing of experimental wounds reported in rats fed a high protein ration [28] and the striking remission of human peptic ulcers when a high protein high calory diet is given [29] Cannon[27] has discussed the effect of protein in promoting resistance to disease Lund[30] has written of the benefits which accrue to surgical patients and of the dangers which can be avoided when the plasma proteins are maintained at a high level

A critical appraisal of these results leads to the conclusion that the reported beneficial effects result from the provision of *adequate* protein not from the addition of superabundant supplies Obviously, in order to insure adequacy the diet should contain more than the minimum requirement for ideal conditions—i e, we should plan practical dietaries in order to provide some margin of safety where this is possible

Conclusion Levels of protein consumption may vary considerably with maintenance of good health Protein especially of animal origin is an expensive nutrient Hence in dietary planning one cannot afford to be overgenerous with it Present evidence supports the reasonableness of the recommended allowances of the Food and Nutrition Board of the National Research Council [31] Men, 70 gm daily, women 60 gm daily (i e, approximately 1 gm per kilogram of body weight) with an increased allowance to 85 and 100 gm during pregnancy and lactation,

respectively This allowance for children varies with age and growth from some 1 5 to 3 5 gm per kilogram of body weight The requirement for infants fed cow s milk is higher than for breast fed infants[32] When it is economically feasible the dietary habits of adults will usually adjust to an intake level higher than these recommended allowances Within reasonable range this upward adjustment is without harm and some would argue may be beneficial

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# 5

## *The Vitamins*

The physician of today, in order to nourish his patient properly, no longer tells him what he should not eat; he tells him what he should eat. This change in the concept of nutrition was brought about by an increasing knowledge of the essential nature of certain nutritive substances termed vitamins—organic substances required in minute amounts in order to preserve health and well-being. The lower animals are accustomed to derive their nourishment from fresh native foods, such as plants and the flesh of other animals. When they are made to live upon purified, highly refined foods, nutritional failure results and characteristic disease often ensues. Certain essential factors, some of them known and others unknown, are lacking in these purified foods. Among them are the minerals and the vitamins. The need for the former has been understood for a long time, but it is only in recent years that their importance has been appreciated. The need for the latter was discovered only within the past forty years, and knowledge concerning them is being rapidly advanced. This knowledge has introduced a new era in nutrition, indeed, a new era in medicine.

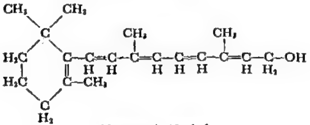
Man's need for some unknown dietary essential was recognized in the scurvy which attacked the crews of the old-time sailing vessels and in the beriberi which in the latter part of the last century was the scourge of the Japanese Navy. Takaki's success in bringing beriberi under control by means of dietary changes in the rations of the Japanese sailor did not appear entirely convincing, because of persisting confidence in the efficacy of the sanitary improvements made at the same time. It was not until the brilliant animal experiments of more recent years became known that the true nature of the missing factors in these and other diseases was understood. The first of these early observations upon animals, later clarified and considerably elaborated by Grijns, was that of Eijkman in the Dutch Indies, who in 1897 described a "nutritional polyneuritis" in fowls similar to that of beriberi in man, which he attributed to the lack of an unknown nutriment present in rice polishings. Sir F. G. Hopkins[1] in 1906 forecast the development of the knowledge of vitamins when he wrote, "I can do no more than hint at these matters, but I can assert that later developments of the science of dietetics will deal with factors highly complex and at present unknown." After this came the epoch-marking discovery, in 1913, of McCollum and Davis[2]

that young animals fed upon purified foodstuffs, such as purified casein, starch and lard, together with an appropriate salt mixture, failed to grow and that normal growth was resumed when butter fat and egg yolk fat were added to the diet They concluded that certain fats contain a dietary essential not hitherto recognized Almost simultaneously similar experiments by Osborne and Mendel[3] showed not only that lack of this essential factor retarded growth, but that in older animals it led to a characteristic disease of the eyes known as xerophthalmia This factor was called by McCollum an unidentified dietary factor, fat soluble A Later the term 'vitamine," proposed by Funk in 1911 to apply to such dietary essentials, was changed slightly in order to escape the 'amine implication, and vitamin A became the accepted name of this factor The two subsequently discovered water soluble factors were called vitamins B and C Today the existence of fourteen vitamins has been clearly established, and the existence of several more has been postulated

The most significant of the recent achievements in this field have been the identification and synthesis of these nutrients All the well characterized vitamins have been isolated in pure crystalline form, and they are now identified by their chemical names Man s requirement is today as a rule expressed in milligrams of the pure substance

The original division of the vitamins into two groups on the basis of their solubilities— fat soluble factors and water soluble factors —retains a usefulness in grouping physiologic characteristics The fat soluble vitamins are absorbed along with the lipids, they are stored in relatively large quantities, and are not normally excreted in the urine, and several forms of each and precursors of some are present in foods The water soluble factors, by contrast, are absorbed more readily even in derangements of lipid absorption, they are stored in amounts sufficient to carry the subject through six weeks to several months of depletion they are excreted in the urine, and the naturally occurring forms are more specific.

VITAMIN A



Vitamin A Alcohol

Vitamin A is the 'fat soluble vitamin" which was discovered by Mc Collum and Davis when they observed that young animals sickened and failed to grow unless butter fat or some other product carrying this then unknown factor was added to their diet of purified foodstuffs It is now known that this vitamin is essential, not only to growth, but also to the animal s health and well being

Two forms of this vitamin are now known, vitamin $A_1$ and vitamin $A_2$ Structurally the two are closely related The latter is found in fresh

water fishes Vitamin $A_1$ is the *substance which is of primary* importance in human physiology, and it will be referred to in the discussion that follows simply as vitamin A This vitamin, in the form of its precursor, the yellow pigment carotene, is widespread in nature, being found chiefly in association with chlorophyll in the green leaves of plants The biologic relationship of these two pigments is unknown but it is a useful qualitative guide in recalling that green leafy vegetables are good sources of vitamin A activity The other parts of plants are as a rule poor in this *factor, but this* is not invariably true, for carotene may be stored elsewhere than in the green leaf For example, yellow vegetables and fruits such as carrots, yams yellow squash, apricots papaya, and others, are especially rich in carotene Because vitamin A is present in nature largely in the form of carotene, it is appropriate that the richness of foods in this respect be expressed in terms of vitamin A value

Carotene in its three isomeric forms alpha, beta and gamma carotene and a related substance, cryptoxanthine, are all capable upon hydrolysis of yielding vitamin A $\beta$ carotene is, however, the most important provitamin A The conversion of precursors to vitamin A takes place in the liver and intestinal wall

*The vitamin* A alcohol is now available in pure form both by isolation from natural materials and by synthesis

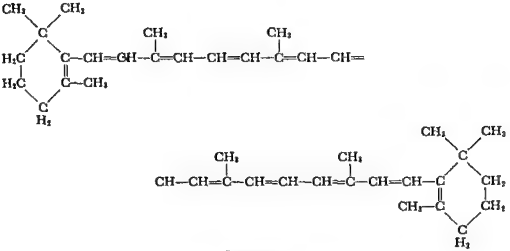
**The Standard** During the evolution of the chemistry of vitamin A and carotene several standards have been used The exact biologic potency of certain of these has been a subject of much study and some confusion The International Standards were originally developed within the Health Organization of the League of Nations and are now sponsored by the World Health Organization of the United Nations The USP units and the Medical Research Council units have usually followed closely the International Standards

Currently the International Unit (I U) of provitamin A is defined as the activity of 0 6 microgram of pure $\beta$ carotene of vitamin A as the activity *of 0 3 microgram of vitamin A alcohol (0 344 microgram of vitamin A acetate)* [4] For practical purposes one may consider that the USP Unit is identical with the International Unit

**Estimation** Carotene and vitamin A may be determined colorimetrically or spectrophotometrically The most widely used method for estimating these substances in blood plasma is one or another modification of the Dann Evelyn procedure [5] We have found the procedure described by Stekol and Kaser[6] a convenient one These are colorimetric methods which measure the intensity of the blue color which develops when a chloroform solution of vitamin A is treated with antimony trichloride (Carr Price reaction)

**Functions** Vitamin A is essential to growth to vision and to the integrity of the epithelial tissues Its influence upon growth is apparently a specific one for it has been shown that deficiency in this respect established sufficiently early will retard skeletal growth in a unique manner The vitamin is essential for the normal moulding and shaping of bones —it seems to direct the orderly activity of the *osteoblasts and osteoclasts*

The part vitamin A plays in vision is perhaps the best understood of



*β* carotene

its functions In the retina it is oxidized to the aldehyde which unites with a protein (opsin) to form the visual purple (*rhodopsin*), but on exposure to light the latter is broken down with a bleaching of this pigment[8] This is a reversible process in which the visual purple is later reconstituted, but the process is not 100 per cent efficient, and for complete restoration a fresh supply of vitamin A must be available Lack of this factor results in impairment of vision with night blindness This is one of the early signs of vitamin A deficiency

A significant function of this vitamin is its influence in maintaining the structural integrity of epithelial cells Without it epithelial structures which have a secreting (chemical) function in addition to that of a covering layer all undergo the same highly characteristic change[9] This takes place through a process of metaplasia in which normal epithelial cells are replaced by a stratified keratinized epithelium It occurs in the mouth and its accessory glands, the respiratory tract, the urinary tract, the prostate, the seminal vesicles the female genital tract, the eyes and the paraocular glands It does not occur in the stomach and intestines

Further evidences of vitamin A deficiency will be discussed in Chapter 14 (p 251 ff)

**Toxicity** Convincing evidence is at hand that massive overdosing with vitamin A can lead to a syndrome known as hypervitaminosis A Josephs[10] described bony changes, splenomegaly, grave anemia and other profound disturbances in a boy of three years who had been given a teaspoonful of halibut liver oil (carrying 240 000 units of vitamin A) daily for most of his life Health was restored except for the splenomegaly, when the oil was discontinued Since that time several cases of intoxication with vitamin A have been described[11] The syndrome occurs most often in children one to three years of age, and the appearance of symptoms is usually preceded by a 6 to 15 month period of excessive intake of vitamin A of 75,000 to 500 000 I U daily as a fish liver oil concentrate

The disease is characterized[11,12] by hyperirritability, swellings over the long bones, dry skin, often pruritus, sparse coarse hair, and elevated

plasma or serum concentrations of vitamin A ranging upward from 300 I U per 100 ml Serum alkaline phosphatase is regularly increased Shell like boney hyperostoses are seen upon x ray examination of the long bones Hypoprothrombinemia is the rule in experimental animals Therapy consists simply in interdiction of the supplementary vitamin

*Synthesis* Synthesis of vitamin A does not take place in the animal body, this factor must in the last analysis be secured from plants The latter provide the ultimate sources from which come the rich vitamin A values of cow s milk and hen s eggs Likewise, the source of the vitamin A values found in the liver of the cod and other fish is believed to be the minute marine plants These plants are eaten by crustaceans which are consumed by small fish these in turn are eaten by larger fish and so on until the still larger fish are devoured by the cod or the halibut The liver of the halibut contains enormous amounts of vitamin A sometimes as much as 1 per cent by weight

*Conversion* The conversion of carotenoids into vitamin A is commonly believed to take place in the liver,[13] but the recent experiments of Deuel[14] and others[15] point instead to the intestinal wall as a possible site for this transformation Such conversion does not proceed rapidly or completely, and animal food products therefore may contain variable mixtures of the vitamin and its precursors For this reason the depth of color of the egg yolk or of the milk, which comes from the pigment carotene, does not necessarily express its full vitamin A value

*Storage* The liver stores about 95 per cent of the body s reserves of vitamin A The vitamin is found also in the kidneys, lungs and fat depots In the livers of three apparently healthy persons who had died suddenly through accidents Crimm and Short[16] found an average of 331 U S P units per gram Two children showed an average of 80 units per gram Four persons who had lived on a high vitamin diet because of pulmonary tuberculosis showed an average of 523 units per gram of liver In the livers of twenty five persons who had died of accidents and showed no evidence of disease Ralli and her co-workers[17] found an average of 1210 units per gram A similar range has been reported by investigators in England [18] The storage in the liver is as a rule lowest at birth and increases with advancing years

In disease of the liver these stores are markedly reduced Low concentrations of vitamin A in this organ have been reported in a number of diseases notably in cirrhosis of the liver From an examination of ninety six livers from patients who had been the victims of alcoholism cirrhosis of the liver and other diseases Ralli and her associates[17] report that the influence of cirrhosis in reducing the vitamin A content of the liver is striking

Many influences alter the concentration of vitamin A and carotene in the blood serum or plasma One cannot set rigid limits of normal values for either, but average vitamin A levels of some 120 I U per 100 ml are usually encountered in plentifully fed populations The older lower limit of normal of 70 I U per 100 ml is rather frequently observed in healthy well fed adults and children Symptoms of avitaminosis A are not encountered until the concentration of the vitamin in the plasma

falls below 50 I U or so [18, 19] The levels of carotene in the blood reflect somewhat the intake Hence they are low in infants and children In healthy adults in the United States the levels vary from about 60 to 200 micrograms per 100 ml of serum

**Absorption and Utilization** The absorption and utilization of carotene and vitamin A depend upon many factors such as the amount taken the degree of body saturation the condition of the intestinal tract and the presence of other substances in the intestine Absorption is facilitated by the simultaneous absorption of a certain amount of fat This problem is further complicated by the fact that the absorption of lipids and such associated materials as vitamin A is profoundly influenced by the bile Carotene is absorbed much less readily than the vitamin In the absence of bile it is not absorbed from the intestinal tract unless bile salts are administered This superiority in ease of absorption of the vitamin over its precursors was observed by Guilbert and his associates[20] *when in their feeding experiments on cattle sheep and swine they* found that for protection against night blindness 6 to 8 micrograms of vitamin A sufficed while 25 to 30 micrograms of carotene per kilogram of body weight were required The efficiency of absorption of carotene varies from food to food The fecal excretion of carotene expressed as percentage of ingested carotene varied between 57 and 73 for green vegetables and from 44 to 76 for carrots which had been homogenized and sliced respectively [18] When therefore an abundance of vitamin A is desired and particularly when there is lack of bile in the intestine those foods which carry the vitamin already formed such as animal foods are to be preferred

The use of certain emulsifying agents permits the dispersion of finely divided droplets of vitamin A in water Such preparations are loosely referred to as water soluble vitamin A The vitamin is more rapidly absorbed when given in this state to healthy subjects premature infants or patients with steatorrhea [21]

**Requirement** Precise setting of the human requirement of the vitamin is not feasible at the present state of knowledge A recent study[18] has resulted in the suggestion that about 1300 I U daily of vitamin A is a minimum protective dose for adults and that 2500 I U should be allowed as a recommended intake with a margin of safety The minimum protective dose of carotene was estimated to be about 1500 I U daily Because of the inefficiency of extraction from foods and the resulting low availability of carotene from some foodstuffs it was recommended that the daily intake of carotene as the sole source of vitamin A be set at about 7500 I U

The Food and Nutrition Board of the National Research Council has adopted a daily recommended allowance"[2] of 5000 to 6000 I U of vitamin A as a goal at which to aim in the planning of dietaries for adults For children these daily allowances are as follows under one year of age 1500 I U one to three years 2000 I U four to six years 2500 I U seven to nine years 3500 I U ten to twelve years 4500 I U

In determining such allowances however there always comes into question the distinction between minimum and optimum There is prob

ably a wide difference. That this is true was indicated by the experience of Sherman and MacLeod,[23] who saw marked superiority in vigor, fertility and resistance to disease in those experimental animals which received an increased allowance of vitamin A. A similar interpretation can be placed on the later experiments of Batchelder,[24] who fed rations of varying vitamin A content to rats through successive generations and reported that the more liberal intake in this respect, the greater the vigor and health of the animals. The greatest vigor was exhibited by those animals which received an amount of the vitamin four times that necessary to protect against obvious deficiency. The conclusion seems warranted that the optimum intake of vitamin A materially exceeds the minimum allowance.

Such estimates of man's requirement of vitamin A do not necessarily hold good under all conditions. Cirrhosis of the liver and probably other diseases (diabetes?) interfere with the conversion of carotene into vitamin A and with the storage of this factor.

In arranging the diet it is not difficult to meet the minimal requirement of vitamin A. If the child takes a pint of milk daily (preferably a quart), two eggs, two liberal helpings of butter and a helping of carrots and some green vegetables, with a little cheese and a helping of liver occasionally, he will be safe as far as vitamin A is concerned. If the adult will take each day two eggs, two helpings of broccoli, turnip greens, carrots or cabbage, the usual amount of butter and one or two glasses of milk, with frequent servings of liver and of cheese, he will probably receive his optimal quota.

*Sources.* The foods which supply man with vitamin A in greatest abundance are green and yellow vegetables, yellow fruits, liver, eggs, milk, butter, and fish liver oils. Although green vegetables are rich sources, the completeness with which they yield this factor during digestion determines in a measure their vitamin A values. Animal food products, such as liver, eggs and milk, contain a relatively larger proportion of the vitamin and less of its precursor, and therefore their yield of vitamin A is more complete, but the richness of such food in this respect depends in turn on the ration of the animal supplying it. Too much emphasis, however, should not be laid upon the immediate effect of the provender, for animals can store large quantities of vitamin A and its precursors for future use and then, during periods of deprivation, avail themselves of these stores. For example, the milk and the eggs of the previously well-fed cow or hen, even though she be given a deficient ration, will for a time continue to carry their usual vitamin A values. The milk sold by eight large distributors in Wisconsin was studied by Dornbush and his associates,[25] who reported that the seasonal changes in carotene content were greater than those in vitamin content. They found the vitamin A potency per gram of butter fat to be fairly constant.

*Stability.* The stability of the vitamin A content depends largely upon the degree of oxidation to which the food is subjected. It is not destroyed by boiling. The destruction which often occurs at high temperatures, such as those used in cooking, does not take place if oxygen or oxidizing agents are excluded. Therefore, the loss, if any, of vitamin A

which occurs during canning or other preparation of foods depends upon the skill with which it is done The film which forms upon milk as it is being cooked, for example, gives protection, while stirring hastens the destruction The presence of rancid fat in stored food materials hastens the loss of vitamin A

Vitamin A is well retained by frozen foods, but it is possible that it may be rapidly lost after defrosting The drying of foods may cause considerable loss of vitamin A, because of the coincident oxidation

Deficiency Diseases Xerophthalmia and the other less graphic disorders which accompany vitamin A deficiency will be discussed in Chapter 14

### VITAMIN B COMPLEX

The story of the vitamin B complex has its beginning in the story of beriberi The recognition in the late seventies by Takaki, a physician of the Japanese Navy, that dietary faults were responsible for the enormous incidence (20 to 40 per cent) of beriberi among the sailors of his country and his success in almost eliminating the disease by means of an improved ration were epoch marking The experiments of Eijkman, who in 1897 produced in fowls with a diet of polished rice, polyneuritis similar to that of beriberi, and the subsequent extension of his work in 1901, by Grijns marked the first experimental production of a deficiency disease Subsequently American Army officers were able by means of an improved ration greatly to reduce the incidence of beriberi in Bilbid Prison in Manila A like effect was accomplished for the Philippine scouts by improving their diet of beef, white flour, potatoes and polished rice through the substitution of unpolished rice for the polished product and the addition of $1\frac{3}{5}$ ounces of dried beans Search for the missing substance continued, and signal progress was made by a group of physicians working in the Malay Peninsula and in the Philippines, notable among whom were the Englishmen Fraser and Stanton and the Americans Chamberlain, Vedder and Williams The latter group reached the conclusion that the antineuritic influence was carried by a nitrogenous base which was distinct from any known alkaloid or amino acid Funk, who prepared a concentrate of the active principle, termed it the antineuritic vitamin It was subsequently established that the protective body postulated by these earlier writers and isolated by Funk is in reality a complex consisting of several otherwise unrelated chemical entities This is now known as the B complex Eleven of its component substances have been obtained in crystalline form thiamine ($B_1$), riboflavin ($B_2$), niacin folic acid vitamin $B_{12}$ pyridoxine ($B_6$), pantothenic acid, choline, biotin inositol and para aminobenzoic acid Some doubt has been expressed as to whether the two last named should properly be considered vitamins but they are commonly so regarded In recent years it has become evident that several chemically similar substances may be present in nature and have qualitatively similar effects as vitamins For example citrovorum factor and the conjugates of folic acid are all active in meeting the requirement for pteroylglutamic acid Thus one may now speak of a family of vitamins in many instances

**Table 19 Vitamin Content of a Few Typical Foods (Elvehjem[20])**

| Foods* | Thiamine† | Riboflavin† | Niacin† | Pantothenic Acid†‡ | Vitamin $B_6$†‡ | Biotin†‡ | Folic Acid†‡ |
|---|---|---|---|---|---|---|---|
| Apples | 0.04 | 0.02 | 0.2 | 0.05 | 0.03 | | |
| Bananas | 0.09 | 0.06 | 0.6 | 0.18 | 0.30 | | 0.01 |
| Bread | | | | | | | |
| White (unfortified) | 0.08 | 0.13 | 0.8 | 0.40 | 0.20 | | |
| White (fortified) | 0.24 | 0.15 | 2.2 | 0.40 | 0.20 | | |
| Cabbage | 0.07 | 0.06 | 0.3 | 0.18 | 0.29 | | 0.01 |
| Carrots | 0.07 | 0.06 | 0.5 | 0.24 | 0.19 | 0.002 | 0.01 |
| Cheese | 0.04 | 0.50 | 0.1 | 0.35 | 0.20 | 0.002 | |
| Cornmeal, degerminated | 0.15 | 0.06 | 0.9 | | 0.25 | | 0.02 |
| Eggs, whole fresh | 0.12 | 0.34 | 0.1 | 2.70 | | 0.025 | 0.01 |
| Meat | | | | | | | |
| Beef | 0.12 | 0.15 | 5.2 | 1.10 | 0.40 | 0.004 | 0.02 |
| Pork loin | 1.04 | 0.20 | 4.4 | 1.50 | 0.60 | 0.005 | 0.01 |
| Poultry, chicken or turkey | 0.10 | 0.18 | 8.0 | 0.90 | 0.20 | 0.01 | |
| Liver, pork or beef | 0.27 | 2.80 | 16.1 | 5.20 | 0.80 | 0.1 | 0.08 |
| Milk, whole fluid | 0.04 | 0.17 | 0.1 | 0.30 | 0.07 | 0.005 | |
| Oatmeal | 0.65 | 0.14 | 1.1 | 1.30 | 0.25 | | 0.03 |
| Oranges | 0.08 | 0.03 | 0.2 | 0.12 | | | 0.01 |
| Peas, fresh | 0.36 | 0.18 | 2.1 | 0.60 | 0.05 | 0.002 | 0.03 |
| Peanuts, roasted | 0.30 | 0.16 | 16.2 | 2.5 | 0.30 | | |
| Potatoes | 0.11 | 0.04 | 1.2 | 0.40 | 0.16 | | 0.01 |
| Spinach | 0.12 | 0.24 | 0.7 | 0.7 | 0.08 | 0.002 | 0.18 |
| Tomatoes | 0.06 | 0.04 | 0.6 | 0.37 | 0.07 | 0.002 | 0.01 |
| Turnips | 0.06 | 0.06 | 0.5 | 0.25 | 0.10 | 0.002 | |
| Yeast, brewers, dry | 9.69 | 5.45 | 36.2 | 20.00 | 2.90 | 0.2 | 0.7 |
| Wheat, whole | 0.56 | 0.12 | 5.6 | 1.30 | 0.40 | 0.005 | 0.05 |

* Edible portion

† Values are given in milligrams per 100 gm

‡ Values for pantothenic acid, pyridoxine (vitamin $B_6$), biotin and folic acid are based on data from a limited number of samples

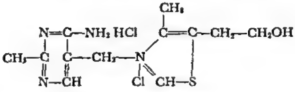
The B complex is as a rule found in nature with all or nearly all of its members present. The proportions vary, but a food rich in one member of the complex usually provides appreciable amounts of the other members also. This, however, is not always true. Liver, for example, provides most of these nutritive factors in liberal amounts, but is relatively poor in thiamine. Vegetables provide riboflavin generously, but as a rule are poor sources of thiamine and pantothenic acid. Whole cereals, on the other hand, are good sources of these last two vitamins but contain little riboflavin and niacin.

For adequate nutrition in respect to the B complex, dependence should never be placed on the known crystalline substances alone. There are probably other, yet unknown, factors in this complex which also are essential, and to secure these the person should endeavor to get the complex as a whole, preferably from his food. Liver, although lacking somewhat in thiamine, is an excellent source of this complex. Yeast also is a rich, dependable source; its use should receive greater encouragement.

The early history of the vitamin B complex is well presented in the Medical Research Council's Special Report Number 167[27] and in Sherman and Smith's 'The Vitamins'.[28] Two good recent monographs on the B complex have appeared and are recommended to the reader for detailed treatment of the subject.[29, 30]

### Thiamine

Thiamine (vitamin $B_1$), the antineuritic factor, has been isolated in crystalline form. Williams and Cline,[31] after many years of brilliant research by the former, accomplished the synthesis. It has been identified by Williams as having the following structural formula:



Thiamine hydrochloride

**Function.** Thiamine pyrophosphate (cocarboxylase) functions as a coenzyme in the decarboxylation of alpha keto acids, especially pyruvic acid, which is an intermediate in carbohydrate metabolism. Peters and his associates, working with pigeons deficient in respect to this vitamin, found that in the presence of glucose certain brain cells exhibited a lowered respiration and that when pure thiamine was added these cells then showed an appreciable uptake of oxygen. Such deficient cells respiring in vitro, accumulate pyruvate, an intermediary product of metabolism, which accumulation is prevented with clearance of the metabolic pathway, when the vitamin is added. After the administration of glucose, persons who are deficient in thiamine exhibit in their blood a pyruvate curve which is abnormally high and prolonged.[32] This fact is the basis of the biochemical metabolic load test proposed as an index of thiamine deficiency. This test is a combination glucose exercise test in which one measures glucose, lactic acid, and pyruvic acid in the blood and expresses their relationship as the 'carbohydrate index.' The index is altered in thiamine deficiency.[33]

Anorexia appears early in thiamine deficiency. The explanation of this is not clear, but it has been suggested that the loss of appetite may be secondary to more remote disturbances in the tissues themselves and therefore "may be regarded as the back pressure of a long series of halted processes."

The tone and motility of the gastrointestinal tract, as well as its secretive activity, are likewise affected. Cowgill, Deuel, Plummer and Messer[34] were able to observe gastric atony associated with thiamine deficiency both through a gastric fistula and in the fluoroscope, and Cowgill[35] demonstrated that this form of avitaminosis is accompanied by diminished gastric secretion. A like influence is apparently exerted upon the musculature of the heart, for although the administration of this vitamin will not affect the normal heart, the lack of it will lead to myo-

cardial necrosis and other profound changes.[36] Indeed, beriberi heart disease is occasionally reported,[37] especially where alcoholism is common.

The most striking and among the most constant of the effects of thiamine deficiency are the changes in the nervous system, at first functional and later organic. An example of the first is seen in the peculiarities observed by Everett[38] in the behavior pattern of cats deprived of this vitamin and of the second in the well-characterized polyneuritis of thiamine deficiency. An explanation of the latter can be found in the previously quoted observation that the metabolism of nerve tissue is profoundly upset by this form of avitaminosis. This cannot, however, according to Wolbach and Bessey,[9] be regarded as a specific lesion in the sense that keratinization of epithelium is characteristic of vitamin A deficiency. These authors conclude that the inability of cells to utilize carbohydrate sufficiently for the needs of normal processes may alone be responsible for the degeneration of neurons.

**Storage.** Storage of thiamine takes place in the body only to a limited extent. Upon a diet rich in this substance an animal may store appreciable amounts against future need. The time required for depletion of thiamine stores varies. Some workers have observed evidences interpreted as thiamine deficiency symptoms within six weeks after placing subjects on low-thiamine diets; others have found that several months to over a year may be required to deplete the subject to a point of a manifest deficiency state.

**Requirement.** Man's requirement for thiamine, according to Cowgill,[35] depends upon three variables: (1) the body weight, (2) the total metabolism or calories utilized, and (3) the maximal weight of the species. To this perhaps can be added a fourth factor, the amount of this substance man is able to synthesize through bacterial action in his own intestine.[39]

The exact requirement is controversial. The Food and Nutrition Board of the National Research Council recommends a daily allowance of 0.5 mg. of thiamine per 1000 Calories, but as a minimum much lower figures have been indicated. Holt[40] concludes that under rigid dietary control the normal human adult's minimal thiamine requirement can be met with 0.13 to 0.17 mg. per 1000 Calories. This is even lower than Keys' figure of 0.23 mg. Alexander and Landwehr[41] found the minimal requirement of a normal male, whose caloric intake was 2400 calories, to be 0.44 mg. per 1000 Calories.

From the studies in the Elgin State Hospital[42] it has been concluded that "an intake of 400 micrograms of thiamine is below the minimal requirement of men who are relatively inactive and whose daily food consumption provides no more than about 2000 Calories." For normal infants, Holt and co-workers[43] found that the requirement for maintaining urinary excretion levels varied between 0.14 and 0.20 mg. of thiamine per day.

Apparently man's requirement for thiamine, when conditions in all respects are favorable, can be met by a much smaller intake than is commonly recommended, but these lower figures would not be safe for universal acceptance. Witness the many variables that influence thiamine

requirement. It is increased in conditions which involve increased metabolism such as exercise, fever, and hyperthyroidism and by anything that interferes with intestinal absorption; it is profoundly influenced also by the amount of carbohydrate metabolized. A liberal factor of safety, therefore, is desirable.

The daily allowance of thiamine recommended by the Food and Nutrition Board of the National Research Council[22] is as follows: for a physically active man of 70 kilograms, 1.5 mg.; for a woman of 56 kilograms under similar circumstances, 1.2 mg.; for a child of one to three years, 0.6 mg.; for a child of four to six years, 0.8 mg.; and for a child of ten to twelve years, 1.2 mg. The need is increased during pregnancy and lactation. For a woman in the latter half of pregnacy and during lactation the recommended allowance is 1.5 mg.

All such statements as to man's need for this vitamin are necessarily relative. Sherman writes that, in general, danger of deficiency is slight unless an unduly large proportion of the caloric intake is in the form of artificially refined foods. He believes that under ordinary circumstances an adequate supply of this vitamin will be assured if half the needed calories are taken as fruits, vegetables, milk, and eggs and if half the cereals and breadstuffs are eaten as the whole grain.

**Toxicity.** Thiamine has no known toxic effects. According to Cowgill[44] it exerts a demonstrable action only in the thiamine deficient animal and has produced no toxic symptoms when given in doses approximating 25,000 or more times the estimated daily requirement.

**Sources.** The foods that contain thiamine are plentiful. This vitamin is of nearly universal occurrence in animal and vegetable tissues in quantities usually varying from 0.14 to 2.04 micrograms per gram. It is removed or greatly decreased by certain processes of refining, especially of cereal products.

Unlike vitamins A and C, however, this factor is seldom supplied by plant or animal foods in anything like concentrated amounts. Relatively large amounts are found only in seeds and in yeast grown in rich mediums. Whole cereals rank high in this respect, the vitamin being found largely in the germ and outer layer of the seeds. Cow's milk and eggs are rich, although butter and cheese are negligible in this respect. Fruits and vegetables, although variable, are important sources. Liver and heart contain more of the vitamin than the muscle meats. Among the latter, however, pork is unique because of its richness in this respect. Rich sources of thiamine are peas, beans, oatmeal, whole wheat, lean pork, and peanuts. An excellent source is brewers' yeast.

**Stability.** The stability of thiamine when subjected to high temperatures, as in cooking, depends to a large extent upon the *p*H of the medium in which the vitamin is dissolved. It is relatively stable in acid solutions and is quickly destroyed in alkaline mediums. Williams[45] states that the loss of thiamine in the cooking of foods is sometimes surprisingly small, a fact which he attributes in part to its presence in combined form. Tomato juice in its normal acidity (*p*H 4.3), when heated to 100° C. for four hours, lost 20 per cent of its thiamine content, which loss rose to 33 per cent at 110° C. and 47 per cent at 120° C. These losses increased with

decreasing acidity and increasing alkalinity of the solution as well as with the length of time of heating.

According to Munsell, no significant loss need be considered in the boiling of vegetables up to one hour, but because of its solubility a large part of this vitamin may be thrown away with the water. During canning, according to this author, there is probably little loss of thiamine owing to processing per se, but in the injudicious preparation of the food considerable amounts may be discarded. Little is known concerning the effect of storage and drying upon the thiamine content of foods except in the case of milk. Losses in the preparation of milk powder are small. Freezing apparently has little effect on the thiamine content of foods.

Sherman summarizes the practical bearing of his studies of thiamine losses as follows:

(1) Vitamin B may be lost to a serious extent mechanically in refining the food or by discarding the water in which the food materials have soaked; (2) actual destruction, e.g., in cooking or canning, is apt to be only a relatively small factor unless the natural acidity of the food has been reduced by addition of alkali; (3) any addition of alkali, any shifting of the hydrogen ion activity toward the alkaline side, whether the neutral point is passed or not, must be expected to increase the rate of destruction of the vitamin, which rate of destruction (diminution) may be negligible at low temperatures but may become serious on heating.

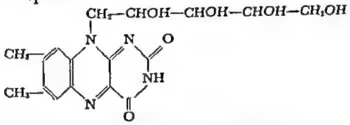
In certain fish there occurs a heat labile thiamine destroying enzyme (*thiaminase*). The feeding of a diet containing 10 per cent of uncooked fish to foxes has been associated with the development of thiamine deficiency ("Chastek's paralysis") due to the activity of thiaminase. In man Melnick and his associates[46] found that the eating of 100 gm. of raw clams (an average serving) divided between three meals would destroy about 50 per cent of the thiamine in the basal diet. The importance of this mechanism for the production of thiamine deficiency in man would appear to be small unless large amounts of uncooked fish constituted a regular portion of the diet.

**Deficiency Diseases.** *Beriberi and the other disorders related to thiamine deficiency will be discussed in Chapter 14.*

**Literature.** For further information regarding the chemistry and physiology of this vitamin the reader is referred to the special articles by Cowgill[44] and Williams,[45] and to the two recent monographs on B vitamins.[29, 30]

## Riboflavin

Riboflavin is a water soluble, greenish yellow pigment with the chemical structure depicted:




6, 7-dimethyl-9-(D-1'-ribityl)-isoalloxazine

It was originally isolated from milk and hence named lactoflavin The name riboflavin was adopted when it was recognized to contain a ribityl moiety

Of considerable biologic interest was the discovery that this body combines with an enzyme to form the yellow enzyme of Warburg a dehydrogenase believed to be present in all the higher forms of living cells This represented the first known direct union of a vitamin with an enzyme and gives some intimation of the part which the vitamin plays in the metabolism of the cell

Function Riboflavin is found in the cell primarily as a mononucleotide and dinucleotide Each of these in combination with a specific protein may serve as enzymes of importance in cellular oxidation

Riboflavin is essential for growth and a deficiency of the vitamin affects especially those tissues of ectodermal origin Deficiency of riboflavin *(ariboflavinosis)* may result in corneal vascularization keratitis and cataract in rats [47] in neurologic changes and in lesions of the skin Riboflavin deficiency in the maternal organism may give rise to congenital malformations in the offspring [48] Acute riboflavin deficiency in dogs may end in sudden death [49] Fatty liver in animals may be caused by ariboflavinosis [50]

In animal experiments Sherman and Ellis[51] showed that increasing amounts of this vitamin in the ration enhanced in corresponding degree the animal s nutritional well being and vigor This improvement in health ascended in a curve parallel to that of the increasing intake of vitamin until the animal received an amount of riboflavin four times that necessary to prevent specific signs of deficiency It is significant that this improvement in health and vitality was often more pronounced in the second generation than in the first Conversely chronic lack of riboflavin in lower animals appears to lessen youthful vigor to lead to early senility and thus to reduce the life expectancy

An early symptom of riboflavin deficiency in man is the growth of capillaries into the cornea first described by Sydenstricker Kruse and their associates [52] Other symptoms are visual fatigue blurred vision photophobia burning and itching of the eyes soreness and swelling of the lids and dermatitis Fissures at the angles of the mouth and nose *(cheilosis)* with reddening and desquamation of the lips are characteristic of this form of deficiency [53] Accumulating evidence however would indicate that while the signs and symptoms just described may undoubtedly be produced by lack of riboflavin and perhaps of other food factors also they are not peculiar to deficiency diseases Ariboflavinosis should not be diagnosed on the basis of these signs alone

Riboflavin is excreted in the urine The quantity so excreted may reflect the customary intake level of the vitamin At a stabilized intake level of 0 55 mg daily the urinary excretion of riboflavin is 30 to 50 micrograms per twenty four hours with an intake of 1 1 mg the excretion is 80 to 110 micrograms and at a consumption level of 2 55 mg 800 to 900 micrograms are excreted [55]

This vitamin is apparently nontoxic It is reported that mice were not injured by doses which were a thousand times the normal requirement

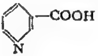
Requirement Man's requirement for riboflavin has not been definitely established The daily allowance recommended by the Food and Nutrition Board for a man of 70 kilograms is 1 8 mg for a woman from 1 5 to 2 0 mg for the child of school age 1 5 mg and for the pregnant or lactating woman from 2 5 to 3 0 mg Corresponding figures from the Canadian Dietary Standards[54] adopted by the Canadian Council on Nutrition are 1 5 mg for the moderately active man 1 1 mg for the moderately active woman and 1 2 to 1 6 mg during pregnancy or lactation The results of the Elgin State Hospital studies[42,55] indicate that the minimal requirement of the vitamin for the prevention of clinical lesions *in the adult male is less than* 0 75 mg daily but greater than 0 55 mg From studies of urinary excretion values it has been suggested that the requirement for an adult male subsisting on 2200 Calories lies between 1 1 and 1 6 mg of riboflavin daily[55]

Sources The foods which supply riboflavin in greatest amounts are milk, liver, eggs and the green leaves of plants Yeast is especially rich in this respect This vitamin is formed primarily according to Sherman and Lanford[56] in the green leaves of actively growing plants where it is retained in higher concentration than in other parts of the plant Of the three tissues constituting the edible portion of broccoli for example the flower buds contain only about half as much as the leaves and the stems contain still less The tops of carrots are four times as valuable in this respect as the rest of the vegetable

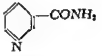
Milk is an excellent and according to the authors just quoted dependable source of riboflavin For children it is the chief source The pasteurization or drying of milk does not seem materially to impair its value but exposure to bright sunlight is particularly destructive

Muscle meats are a fair source of riboflavin These are however greatly inferior to liver, which has about fifteen times the value of the former

## Nicotinic Acid (Niacin)




*Nicotinic Acid*




*Nicotinamide*

Nicotinic acid or niacin $C_5H_4N$ (COOH) is the beta monocarboxylic acid of pyridine It is an unusually stable compound and since it withstands heat and oxidation can be boiled or autoclaved without loss of potency Nicotinic acid amide has the same therapeutic value as nicotinic acid and does not produce the flushing of the skin and itching caused by the latter The amide is more soluble in water *Because of* objections to the name the Council on Foods and Nutrition of the American Medical Association has approved as synonyms for nicotinic acid and nicotinic acid amide the names niacin and *niacinamide*

After the report by Elvehjem[57] and his associates of the effectiveness of nicotinic acid in the treatment of black tongue numerous papers[58,59,60,61,62] appeared indicating *that niacin has* antipellagra activity

**Function** Niacin serves in the body as a component of two coenzymes, coenzyme I, or cozymase and coenzyme II The two are similar in structure, and both are concerned in glycolysis and cell respiration [29 30 63] Each coenzyme, in combination with a variety of specific proteins may be involved in the transfer of hydrogen in many metabolic reactions The failure of no one of these reactions has however, been related causatively to the symptoms of pellagra

Niacin is an essential nutritive substance, and lack of it will produce black tongue in the dog and pellagra in man There is evidence that this vitamin can be produced by synthesis in the human gut and that the variability of such synthesis may be a factor in the pellagra problem [64]

**Metabolism** Several end products of niacin metabolism have been identified in the urine of man and lower animals [65] The major derivatives in human urine are $N^1$ methylnicotinamide and N methyl 6 pyridone 3 carboxylamide Trigonelline is now recognized as existing in urine without reference to nicotinic acid ingestion The estimation of pyridine derivatives in urine is not particularly helpful in diagnosis

The essential amino acid tryptophan serves as a precursor of niacin for growth of the rat and as a source of niacin derivatives in the urine of man and laboratory animals [66 67 68 69] Indeed it is the sole source of nicotinic acid for the mould Neurospora [70 71] Tryptophan is curative in human pellagra [72 73] These facts bear directly upon the interpretation of the antipellagra activity of food and the estimate of the human requirement of niacin

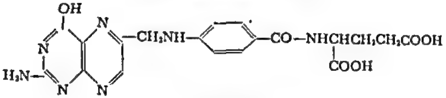
**Requirement** The human requirement of niacin cannot be simply defined It is related to the quantity and quality of protein in the diet—the amino acid tryptophan may reduce the niacin requirement In addition there may be a pellagragenic agent in some foods notably corn [74] Dann[75] presented evidence from dietary studies that the minimum requirement for a 70 kilogram man is probably less than 10 mg daily and that the requirement is increased on diets containing large quantities of maize The daily allowance recommended by the Food and Nutrition Board of the National Research Council for a man of 70 kilograms is from 12 to 18 mg for a woman of 56 kilograms from 14 to 15 mg for the child of school age from 8 to 12 mg and for the pregnant or lactating woman 15 mg These estimates are substantially greater than those proposed by the Canadian Council on Nutrition [54]

The daily recommended allowance may be met by one serving of liver two servings of lean meat or 100 gm of peanuts Although material amounts of the vitamin may be discarded with the water in which vegetables are boiled there are no appreciable losses in the actual cooking

**Sources** The richest sources of niacin are liver and peanut butter Yeast also is an excellent source Breast of chicken ranks with liver but the other muscle meats are considerably lower Fruits and vegetables as a rule are low containing only 1 to 17 micrograms per gram There is a wide difference between wheat and corn the former assaying 45 to 70 and the latter 10 to 15 micrograms per gram Milk and eggs are poor sources of this vitamin

The reviews by Handler[76] and Harriette Chick[77] provide an excellent discussion of the metabolic relationships of niacin.

## The Folic Acid Group



Folic Acid

The recognition of this group or family of vitamins occurred because of a variety of effects on several test organisms. Accordingly, an assortment of names has been used to designate the factor.[78] Among these may be mentioned vitamin M, vitamin $B_c$, folic acid, and *L. casei* factor. The simplest active member of the group is pteroylglutamic acid. Folacin is the synonym adopted by the American Institute of Nutrition[79] to designate pteroylglutamic acid. Two conjugated forms of this factor are found in nature: the fermentation factor, or pteroyltriglutamate, and the pteroylheptaglutamate, commonly referred to as folic acid conjugate. These contain three and seven glutamic acid residues in the side chain.

Of the several assay methods available for determination of the factor, the microbiological procedures are most widely used. The assay methods do not yet allow of general clinical application.

A metabolite of folic acid, known as citrovorum factor[80] or folinic acid,[81] occurs in the urine of man and animals and is increased in quantity after ingestion of pteroylglutamic acid. It has been prepared synthetically[82] and the natural product isolated.[83] It is a formyl derivative of reduced pteroylglutamic acid. It has greater microbiologic activity than folic acid for some organisms, but its relative activity for man has not been established.[84]

**Manifestations of Deficiency.** A deficiency of folacin was first clearly recognized by Day and his associates[85] to result in anemia, leukopenia, diarrhea, and gastrointestinal lesions in monkeys. A similar pattern or a slight variant of it occurs in experimental deficiencies in other species.[86] The experimental production of a deficiency of these factors has not been reported in man. However, the diseases of man (sprue, megaloblastic anemia of infancy, pernicious anemia of pregnancy, nutritional macrocytic anemia) which respond to therapy with folacin are characterized by anemia with megaloblastic hyperplasia of the marrow, usually [illegible] said, therefore, that these factors are involved in hemopoiesis and in maintaining normal gastrointestinal physiology.

**Function.** Intensive investigations are under way in an effort to define the precise metabolic function or functions of the pteroylglutamates. First, it should be noted that the conjugated forms of the pteroylglutamates may be converted into pteroylglutamic acid by the action of en-

zymes[87] known as conjugases which are present in human tissues The in vivo effectiveness of these enzymes has been demonstrated Furthermore certain materials contain factors which inhibit the activity of these enzymes these factors being known as conjugase inhibitors Simultaneous ingestion of a conjugase inhibitor and of the hexaglutamyl conjugate results in lower urinary excretion levels of the free vitamin than is observed when the conjugate alone is ingested[88] This indicates that the conjugase inhibitor can interfere with the availability of the conjugate Accordingly final estimates of the availability of the folic acid group from foods await considerable elucidation of the distribution and relationships of both the several forms of pteroylglutamates of conjugase and of conjugase inhibitor

The conversion of folic acid to citrovorum factor by liver tissue is augmented by the presence of ascorbic acid[89] May and his co workers[90] have found that monkeys fed on a milk diet without vitamin C acquire a megaloblastic anemia which can be relieved by feeding ascorbic acid folic acid or citrovorum factor The mechanism of this interrelationship between vitamin C and the pteroylglutamates may be that ascorbic acid plays a role in the conversion of folacin to citrovorum factor There are other evidences of a close metabolic association between the pteroylglutamates and ascorbic acid[91 92]

Folic acid is in some manner involved in the metabolism of several amino acids—glycine[93 94] tyrosine[91 92] glutamic acid[95] and histidine[96] It is essential for the formation of labile methyl groups in the animal organism and thereby is related to the metabolism of methionine[97 98] (which amino acid contains a labile methyl group) The activity of some enzyme systems is altered in folic acid deficiency For example choline oxidase activity is reduced The significance of these findings has not been elucidated

The exact metabolic importance of citrovorum factor cannot be stated at this time Perhaps the most interesting property of this compound is its ability to reverse the antivitamin activity of some of the folic acid analogues[99]

Requirement Folic acid is obviously an essential metabolite The dependence of normal man upon a dietary supply of the vitamin remains to be demonstrated Therapeutic effects in anemic human subjects have been observed with quantities as low as 1 mg per day The lowest recorded effective therapeutic dose of this vitamin would appear to be in an instance of megaloblastic anemia of infancy treated with oral doses of 200 micrograms per day[84] It seems reasonable therefore to speculate that 100 micrograms to 1 mg of folic acid activity may meet any dietary requirements of the normal human being For therapeutic purposes 5 to 15 mg of pteroylglutamic acid orally or parenterally per day are sufficient for those patients with sprue nutritional macrocytic anemia pernicious anemia of pregnancy or megaloblastic anemia in infancy which respond to folic acid

Sources The complexities of the analysis of foodstuffs for folic acid content have not been resolved For example Hodson[100] applied two microbiological methods and a chick assay technic to the study of the

folic acid content of milk Data obtained by the separate technics were not in agreement, and he concluded that *it was not possible* to arrive at an accurate estimate of the average of the folic acid content of this food

Storage and cooking losses of folic acid may be considerable Thus Eager and co-workers[101] found it necessary to store vegetables under refrigeration in order to prevent significant losses in the folic acid content Hanning and Mitts[102] found cooking losses ranging from 18 to 18 per cent of the folic acid present in eggs Losses were of similar magnitude regardless of whether the eggs were scrambled fried or poached

The following qualitative classification of foodstuffs in relation to folic acid content appears to be as satisfactory as can be derived at the present time

Very high—fresh, deep green, leafy vegetables liver
High—fresh green vegetables, cauliflower, kidney
Medium—beef, veal, dry breakfast cereals prepared from wheat, eggs
Low—root vegetables, tomatoes, cucumbers, light green leafy vegetables, bananas pork, ham, lamb, cheese, milk, dry breakfast cereals prepared from rice or corn, and many canned foods

Literature Valuable brief but comprehensive reviews have appeared in Nutrition Reviews [103]

## Vitamin $B_{12}$

The use of a diet containing liver in pernicious anemia was recommended by Gibson and Howard[104] in 1923 and firmly established by the observations of Minot and Murphy,[105] who prescribed large quantities of the food Castle[106] demonstrated that the deficiency of a food *(extrinsic)* factor in pernicious anemia is conditioned by a lack of a gastric *(intrinsic)* factor The numerous efforts to isolate the extrinsic factor culminated in 1948 in the crystallization from liver of vitamin $B_{12}$[107] and the demonstration of its clinical effectiveness[108] in pernicious anemia This antipernicious anemia factor is now recognized as a nutrient essential for growth and hemopoiesis in many species—chickens pigs rats and dogs It is a growth factor for some microorganisms although others synthesize it.

The chemical structure of vitamin $B_{12}$ is not yet elucidated [109] It is a relatively large molecule (molecular weight of approximately 1300) which contains cobalt Among the moieties isolated as degradation products are 5,6 dimethylbenzimidazole, a ribose derivative of this benzimidazole, and 1 amino-2 propanol A cyan group is attached to the cobalt atom Replacement of the cyan group with a hydroxyl group gives rise to vitamin $B_{12a}$ The exact number of chemically similar substances occurring in nature and having vitamin $B_{12}$ activity is uncertain at this time Much of the vitamin $B_{12}$ activity in foods appears to be present as a protein complex in so called bound form The bound vitamin is inactive for most microorganisms, but may be released by the action of proteolytic enzymes or other hydrolytic procedures

Vitamin $B_{12}$ is synthesized by many microorganisms—those present in the gastrointestinal tract of patients with pernicious anemia as well as of

ealthy subjects A common commercial source of the factor is the fer nentation liquors of *Streptomyces griseus* [110]

**Absorption and Metabolism** The primary defect in pernicious anemia ppears to be the inability to secrete intrinsic factor in the gastric juice n the presence of this defect ingested vitamin $B_{12}$ is ineffective (unless he dose is massive) The oral administration of normal human gastric uice along with the vitamin $B_{12}$ potentiates the activity of the vita nin [111,112] It may be hypothesized, therefore, that the intrinsic factor required for the absorption of vitamin $B_{12}$ Since parenterally admin tered vitamin $B_{12}$ is effective in pernicious anemia, it cannot be as umed that the interaction with intrinsic factor in the stomach is a rerequisite for the activation of the vitamin Furthermore, it appears hat vitamin $B_{12}$ can be utilized locally upon injection into the marrow f patients exhibiting megaloblastosis [113]

The administration of effective quantities of vitamin $B_{12}$ to patients ith pernicious anemia relieves the many symptoms of the disease The lossitis[114] and sense of well being respond within a few days The occur ence of peripheral reticulocytosis on the fourth to eleventh day marks he initiation of the erythropoiesis and reversion of the marrow from the icture of megaloblastic hyperplasia through normoblastic hyperplasia o normal These cellular changes in the marrow following treatment vith vitamin $B_{12}$ are associated with a decrease in the condensation and lumping of cytoplasmic ribonucleic acid in the early erythroid cells [113] There is much other evidence for a metabolic association between nucleic cid metabolism and vitamin $B_{12}$ Where there is combined system dis ase of reversible degree, it improves[115,116] under therapy with vitamin $B_{12}$ Obviously vitamin $B_{12}$ has to do with both the maturation of blood ells possibly through some influence upon ribonucleic acid metabolism nd the metabolism of the nervous system

Vitamin $B_{12}$ plays a role in the metabolism of labile methyl In the at this vitamin is involved in the methylation of homocystine [117] it has a choline or methionine sparing effect as measured by the prevention of hemorrhagic kidneys [118] and a lipotrophic effect [119] Finally, Dinning nd his co workers[120] have presented data which may be interpreted that betaine (a source of labile methyl) in the presence of vitamin $B_{12}$ favor ably influences leukopoiesis These several mutually sparing effects of abile methyl folic acid vitamin $B_{12}$ and related substances and their nfluences on the degree of a deficiency syndrome observed in experi mental animals lend an understanding to the variations of syndrome patterns which may be observed in clinical practice

The development of a deficiency of vitamin $B_{12}$ may be aggravated by the feeding of iodinated casein containing thyroxine The importance of this observation for human nutrition has not been defined but it may signify that the requirement of the vitamin is partly dependent upon metabolic rate

**Requirement and Therapeutic Dosage** Knowledge of the dependence of the normal subject upon dietary sources of this vitamin and of the fate of ingested vitamin $B_{12}$ is too meager to attempt an estimate of requirement The efficiency of absorption in normal persons has not

been defined. It is apparent, however, that if the normal human being requires a dietary supply of this factor, the level is of the magnitude of microgram quantities.

West[108] early estimated that one microgram of the crystalline vitamin was equivalent to a USP unit of parenterally administered antipernicious anemia liver extract. This indicates that a microgram per day should suffice for maintenance of a patient with pernicious anemia. Findings of others have usually supported this estimate, but Ungley[122] implies that such an estimated dosage may be lower than optimal.

*Sources.* Assay procedures for this factor are difficult and still in the developmental stage. The problems of liberation of bound forms, of specificity, especially of the microbiologic technics, and of interpretation of quantitative equivalency of forms of the vitamin are some of the unsolved difficulties. Accordingly, qualitative ratings only of sources are possible.

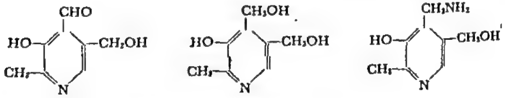
Smith[100] states that it is probable that the sole primary source of vitamin $B_{12}$ in nature is the metabolic activity of microorganisms. It is probably not present at all in vegetable foods, and its association with proteins of animal origin brands it as an "animal protein factor."

Rich sources of the vitamin are organ meats (liver, kidney) and rumen contents; fresh muscle meats are intermediate sources; milk and milk products appear to be poor sources of the factor.

## Vitamin $B_6$

Vitamin $B_6$ was defined as "that part of the vitamin B complex which is responsible for the cure of a specific dermatitis developed in young rats on the vitamin-free diet supplemented with vitamin B, and riboflavin." The specific dermatitis has been termed *rat acrodynia* because of its superficial resemblance to the clinical syndrome of acrodynia. Pyridoxine deficiency dermatitis is *not* the experimental counterpart of acrodynia in the human being, and pyridoxine is not effective in the treatment of the human disease.

*Chemically,* pyridoxine is 2-methyl-3-hydroxy-4,5-(hydroxymethyl)-pyridine.[123]




Pyridoxal Pyridoxine Pyridoxamine

Two additional members of this group of vitamins are pyridoxamine and pyridoxal, 4-aminomethyl and 4-formyl derivatives respectively.[124] These compounds have greater activity for the lactic acid bacteria than does pyridoxine itself,[125] and equal activity in rats. Accordingly, the nomenclature recommended by the American Institute of Nutrition[79] is "that the term vitamin $B_6$ be used as a group name to include pyridoxal, pyridoxamine and pyridoxine, and that these specific names be used

only where the corresponding chemical compound is meant (This recom mendation specifically recognizes that the terms vitamin $B_6$ and pyri doxine should no longer be used synonymously)

**Effect of Vitamin $B_6$ Deficiency** In addition to a dermatitis experi mental animals may exhibit a microcytic hypochromic anemia [126] hyper ferremia and hemosiderosis [127] fatty livers [128] epileptiform seizures and ataxia [129] Demyelinization of peripheral nerves and cord changes have been noted [130] The vitamin $B_6$ deficient animal excretes a metabolite of tryptophan xanthurenic acid [131] and exhibits a progressive decrease in the urinary excretion of $N^1$ methylnicotinamide after doses of trypto-phan [132]

Analogous findings have now been reported in pyridoxine deficiency in man After the administration of the antagonist desoxypyridoxine Mueller and Vilter observed the appearance of seborrhea like skin lesions glossitis stomatitis and cheilosis These lesions were relieved by pyridox ine [133] In infants on a pyridoxine free diet Holt and his co workers[134] found a disappearance of pyridoxine derivatives from the urine a loss of the ability to convert tryptophan to nicotinic acid growth failure convulsions and hypochromic anemia All these abnormalities were corrected by the administration of pyridoxine In adults fed a vitamin $B_6$ deficient diet Greenberg and associates[135] observed an excretion of xanthurenic acid in response to dosing with tryptophan McGanity and his co-workers[136] found that the blood urea was lower in cases of hyper emesis gravidarum than in normal pregnancy and that the level was restored to normal after pyridoxine administration (40 mg of pyridoxine hydrochloride daily) In addition in hyperemesis there occurred a sus tained blood urea level after a load test of alanine This was corrected by treatment with pyridoxine These reports although largely uncon firmed as yet indicate that vitamin $B_6$ is an essential metabolite for man and may be a dietary essential under some conditions at least

**Metabolism** Huff and Perlzweig[137] demonstrated that the ingestion of pyridoxine results in the urinary excretion of 4 pyridoxic acid (2 methyl 3 hydroxy-4 carboxy 5 hydroxymethylpyridine) and described a fluorescent method for its determination This acid is obviously the fur ther oxidation product of pyridoxal

Normally pyridoxine is excreted in the urine in insignificant traces 4 pyridoxic acid accounts for 90 per cent or more of the total pyridoxine derivatives in the urine Ingestion of pyridoxal pyridoxamine or pyri doxine increased the 4 pyridoxic acid excretion the greatest increase followed the ingestion of pyridoxal The ingestion of neither pyridoxal nor pyridoxamine increased the excretion of pyridoxine The data in dicate that conversion from pyridoxine to 4 pyridoxic acid is more likely than in the reverse direction A large portion of the ingested pyridoxine cannot be accounted for in the urinary excretion of these recognized derivatives [138] On the other hand when both fecal and urinary levels are determined much more vitamin $B_6$ and 4 pyridoxic acid are excreted than are ingested This finding is consistent with the interpretation that synthesis of the vitamin occurs in man [139]

**Requirement** It is obviously not possible to estimate the requirement

of this factor at the present writing Furthermore, there is no systematic differential analysis of foodstuffs for the members of this group

## Other Members of the Vitamin B Complex

**Pantothenic Acid** This factor[140] is a member of the B vitamin group The role of this vitamin in human nutrition has not been determined Chemically, the substance is made up of two moieties, α, γ-dihydroxy β, β′ dimethylbutyric acid and β alanine, which are in turn joined through a peptide linkage The calcium salt, calcium pantothenate, is the form of the synthetic vitamin which is available

There is much evidence for a role of pantothenic acid in the metabolic activities of the adrenals In experimental animals a deficiency of the vitamin may result in fatal hemorrhagic adrenal cortical necrosis[141] and other changes which have been interpreted[142] as evidences of an 'alarm reaction' Adrenalectomized rats are well maintained if given large doses of pantothenic acid plus sodium chloride[143] Loss of hair pigment (*achromotrichia*) occurs in deficient black rats although a lack of pantothenic acid is not a cause of gray hair in the human being[144]

The adrenal is active in the metabolism of acetyl groups—which groups are used in the synthesis of steroids Pantothenic acid is present in an enzyme (coenzyme A) which is involved in the acetylation of substances such as para aminobenzoic acid, sulfanilamide and choline[145] It is understandable, therefore, that acetylation of para aminobenzoic acid and sulfanilamide is interfered with in pantothenic acid deficiency in rats[146]

A lack of this vitamin is sometimes associated with impaired leukopoiesis[147] and with lesions in the nervous system[130] The counterpart of none of these defects in human nutrition has been reported, although it has been suggested that the "burning feet" syndrome may be related to a lack of pantothenic acid[148]

This vitamin seems to be widely distributed in nature, liver, meat, cereal, and milk being reliable sources

**Choline** Trimethyl β hydroxyethyl ammonium hydroxide, or choline is one source of labile methyl groups for metabolic activity Under proper conditions therefore, it or a metabolic relative may become essential in the diet Choline deficiency in experimental animals may result in several syndromes[149 150 151] fatty liver and, subsequently, cirrhosis, hemorrhagic kidney with later development of a renal type of hypertension, and perosis and other changes In depancreatized dogs maintained on insulin, choline will prevent the fatty liver which commonly develops

Choline occurs in foods primarily as a portion of the phospholipid molecule Furthermore, choline is but one of several sources of labile methyl other sources are methionine from protein of good biologic value, betaine and newly synthesized methyl the capacity for synthesis and utilization of which is partly dependent upon the folacin and vitamin $B_{12}$ available[152] Obviously, therefore, it is not possible to state a reasonable estimate of the human requirement of choline Indeed the evidence indicates that even when it may be suspected that choline lack has played a role in the pathogenesis of a disease dietary correction with

the provision of generous protein in the form of milk eggs and meat suffices to provide sufficient choline

**Inositol**[153] Hexahydroxycyclohexane or inositol is a simple non nitrogenous substance which has been known for a century to occur in tissues Since the demonstration that it serves as a growth stimulant for yeast the nutritional significance of inositol for several species has been investigated Evidence for its essentiality for mice rats guinea pigs hamsters and chickens has been presented Inositol has a lipotropic activity[154] a property which may be related to its presence in a group of phosphatides[155] (lipositol brain diphosphoinositide) No role in human nutrition can yet be assigned to this compound

**Biotin** Biotin is an essential factor necessary for the growth of bacteria It is a cyclic derivative of urea and as a methyl ester has been isolated from the liver[156] Both biotin and the ester have been obtained in crystalline form The synthetic vitamin is now available at a greatly reduced cost

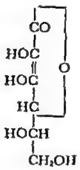
It has been suggested that biotin is concerned in carbohydrate metabolism probably in the utilization of lactate and pyruvate[157,158] It is best known however in its relation to egg white injury Egg white contains avidin which has the property of uniting with biotin and thus rendering this factor nonabsorbable and inactive[159] By this means when fed in sufficient amounts to the rat egg white causes a deficiency of biotin and leads to the production of the syndrome of dermatitis spectacled eye alopecia and finally spasticity The syndrome can be cured by feeding an amount of biotin well in excess of that inactivated by the egg white A dermatitis of the feet characteristic of biotin deficiency has been described in the chick and the turkey Little is known of the significance of biotin in human nutrition Sydenstricker and his associates[160] reported a scaly dermatitis extreme lassitude insomnia and other symptoms in previously healthy persons who were given a refined diet containing large quantities of egg white Administration of a biotin concentrate caused these symptoms to disappear The failure of others to confirm this report is unexplained but may in part be related to the variability in intestinal synthesis of biotin in the different subjects

**Para aminobenzoic Acid** Para aminobenzoic acid is a simple derivative of benzoic acid It is a growth factor for certain microorganisms and is an antagonist of sulfonamide drugs The claim that it will promote growth and lactation in rats has not been confirmed and the claim that it will prevent the graying of hair in man has been controverted Its effectiveness in the treatment of rickettsial diseases[161] is not dependent upon a vitamin like activity There is some doubt as to whether para aminobenzoic acid can be regarded as a dietary essential but significance can possibly be attached to the fact that it takes part in the structure of the folic acid group

## ASCORBIC ACID (VITAMIN C)

In 1734 Bachstrom[162] wrote that From want of proper attention to the history of the scurvy its causes have been generally though wrongfully supposed to be cold in northern climates sea air the use of salt

meats and so forth whereas this evil is solely owing to a tota stinence from fresh vegetable foods and greens which is alone the primary cause of the disease Lind Budd and others clearly po to the presence of an antiscorbutic in foodstuffs The experimental duction of scurvy in the guinea pig by Holst and Froelich (1907 1 provided an experimental tool for the study of this substance in f Finally in 1932 Waugh and King[1r 1] isolated from lemon juice a cr line substance with high antiscorbutic activity which was identical the hexuronic acid which had previously been obtained by Szent Gy from the adrenal cortex The identity of this substance with the scorbic vitamin C was established Shortly thereafter its synthesis accomplished and it was given the name ascorbic acid Because c therapeutic implications the name ascorbic acid was objected to by Council on Pharmacy and Chemistry of the American Medical Ass tion and the designation cevitamic acid was proposed The former n however is so firmly entrenched in chemical literature that the Co finally waived this objection and gave preference to the name asc acid Its structural formula is



L Ascorbic Acid

Inasmuch as ascorbic acid is easily oxidized and inactivated by l in the presence of oxygen an appreciable loss of the vitamin may o during the processing of food

The chemical estimation of ascorbic acid is sufficiently simple to applied to biological fluids for diagnostic purposes The widely used cedures are based on one of two principles (*a*) the decolorization of T mans dye (2 6 dichlorophenolindophenol) owing to the reducing p erty of ascorbic acid (determinations based on this principle measure reduced form of ascorbic acid) (*b*) the development of a colored react product when dehydroascorbic acid is permitted to react with 2 4 d trophenylhydrazine This latter method is the Roe Kuether technic The reader who may be interested in the determination of vitami is referred to the excellent treatises edited by Dann and Satterfield and by Gyorgy[166]

The concentration of ascorbic acid in the blood plasma is a use indication of the recent level of dietary intake of the vitamin Serum plasma concentrations of ascorbic acid above 0 6 mg per 100 ml associated with satisfactory intakes of vitamin C Concentrations in

plasma ranging from 0 0 to 0 6 mg per 100 ml are usually indicative of unsaturation The absence of detectable quantities of ascorbic acid from the plasma or serum is frequently encountered without the presence of scurvy On the other hand untreated clinically manifest scurvy is not encountered in the presence of detectable quantities of ascorbic acid in the plasma

Function Ascorbic acid is necessary for the formation of intercellular substances and a deficiency of the vitamin is marked by the failure of deposition of collagen osteoid or dentine by the fibroblasts osteoblasts or odontoblasts respectively This function accounts for the impaired wound healing observed in vitamin C depleted organisms It is probably also related to the frequent hemorrhage which is observed in scurvy

Ascorbic acid enables the organism to metabolize large quantities of the aromatic amino acids tyrosine and phenylalanine [167,168] Thus in the premature or the scorbutic infant the administration of added quantities of these amino acids is followed by an increased urinary excretion of the intermediary metabolites p hydroxyphenylactic and p hydroxyphenylpyruvic acids [167]

As was discussed in the section on the pteroylglutamates there is considerable evidence indicating that ascorbic acid plays a role in the conversion of pteroylglutamic acid into citrovorum factor [89,90] In a case of human scurvy it was observed that maximal excretion of citrovorum factor occurred only when both pteroylglutamic acid and ascorbic acid were given [169] This was taken as further evidence that ascorbic acid facilitates the conversion of pteroylglutamic acid to citrovorum factor in man

An increased rate of secretion of the adrenal cortical hormones is associated with a sharp fall in the cholesterol and ascorbic acid content of the adrenals The exact link in the association of this vitamin with the secretory process of the adrenal remains to be defined [170]

There is considerable difference of opinion as to whether ascorbic acid may be essential for hemopoiesis Anemia may or may not be associated with the scorbutic state When present it may be microcytic normocytic or macrocytic [170,171,172,173,174] The future clarification of the relationship of vitamin C to folic acid may permit a clearer understanding of the role of ascorbic acid in hemopoiesis

A great many physiologic disturbances have been attributed to a lack of vitamin C reduced complement production increased susceptibility to rheumatic fever lowered resistance to toxins lowered glucose tolerance lowered basal metabolism and other evidences of physiologic disorder It is probable however that these effects are not specific but rather are indirect and due in large measure to lowered vitality As a recent reviewer[170] puts it Ascorbic acid treatment has been reported effective in a host of clinical conditions such as diabetes muscular fatigue radiation sickness hay fever rheumatic fever drug sensitivity metal poisoning pernicious anemia and arthritis None of this evidence is complete enough sound enough or strong enough at this time to warrant further comment

*Synthesis* The synthesis of vitamin C in the animal body takes place in many species for example the rat and the chicken Man monkey and the guinea pig however, must be provided with the vitamin from exogenous sources

*Storage* The adult may store ascorbic acid in sufficient quantities to carry him through a period of several weeks of deprivation Farmer[176] observed that it required some ten weeks to deplete healthy, young adults of ascorbic acid to the point where the vitamin had disappeared from the blood plasma Others have noted that the development of clinical scurvy requires a depletion period of several months [177] Vitamin C is concentrated in certain organs which are the site of considerable metabolic activity Thus high concentrations of the vitamin are found in the adrenals the pituitary gland the corpus luteum and the thymus Progressively decreasing concentrations are observed in the pancreas liver spleen testis ovary, brain thyroid submaxillary gland and intestinal mucosa [178]

*Requirement* Sharp differences are noted as to the estimated requirement and desirable intake of ascorbic acid Certainly an intake level of a relatively few milligrams of vitamin C per day will suffice to prevent scurvy There is much evidence to support the viewpoint that there are advantages in terms of health to be gained from a more liberal intake of the vitamin than the bare minimum Thus Linghorn and his associates[183] found that gingivitis develops more rapidly in subjects on a low intake of ascorbic acid than in those with intakes above 23 mg daily

The British opinion favors an intake standard of some 30 mg of ascorbic acid per day This is in keeping with the old League of Nations recommendation On the other hand the Food and Nutrition Board of the National Research Council has adopted a more liberal standard of 75 mg per day

As is true of most of the vitamins the estimate of man s requirement varies greatly depending upon the criteria used for arriving at the estimate Thus if the maximum retention is taken as a criterion Everson and Daniels [180] from studies of three boys of preschool age advocate an intake of approximately 120 mg of ascorbic acid daily as the ideal Ralli and her co-workers[181] report that the smallest daily dose on which they could reach and maintain saturation in their human subjects was 100 mg daily They concluded that this quantity represented the optimal requirement of the vitamin for an adult

From the studies of Johnson and his associates[182] it is apparent that the total deprivation of vitamin C for two months does not lead in manual workers to detectable deterioration in physical vigor to inefficiency in the day s work or to unpleasant symptoms provided the daily intake is adequate in all nutrients other than vitamin C Johnson further found that the administration of 75 mg of ascorbic acid daily to these subjects was adequate to maintain or even increase the body stores of the vitamin but that amounts in excess of this accomplished no recognizable benefits

The Food and Nutrition Board recommends as a standard for the

70 kilogram man a daily allowance of 75 mg for a woman of 56 kilo grams 70 mg for the pregnant woman 100 mg for the nursing mother 150 mg for children of school age 60 to 75 mg

Sources The foods which contain vitamin C in greatest amount are oranges tangerines lemons and grapefruit (raw or canned) tomatoes (raw or canned) fresh strawberries green peppers cabbages broccoli cauliflower turnip greens kale spinach and certain specialized foods Guava has recently come into prominence as an especially rich source of this vitamin One hundred grams of the fresh fruit contain 300 to 400 mg of ascorbic acid and from the dried fruit a pleasantly aromatic powder has been made which is reported to contain 2500 to 3000 mg to the pound [184] Another rich and seldom used source of ascorbic acid is the fruit of the Emblic tree of India and South Africa the juice is re ported to be ten times as potent as lemon juice The West Indian cherry[185] containing 1 7 to 2 9 gm of vitamin C per 100 gm is one of the richest known foods in ascorbic acid Rose hips and Indian poke ( poke salad ) are also valuable sources of this vitamin

Potatoes are especially important suppliers of ascorbic acid because of the quantities consumed Indeed Hess[186a] termed the potato the main antiscorbutic bulwark of man and quoted Holst and Froelich to the effect that all scurvy epidemics in Norway in the nineteenth and beginning of this century followed failure of the potato crop

Although the mature grains are poor sources of vitamin C the actively sprouting grains and legumes are excellent sources The same can be said of growing shoots and other actively functioning parts of plants The researches of a group of French investigators indicated that like carotene ascorbic acid is to be found in close association with chloro phyll in the green parts of plants [186] In spite of the losses which occur in cooking and canning green leafy vegetables when properly prepared are valuable sources of this vitamin

The vitamin C potency of many fruits and vegetables varies with the conditions under which they are grown Certain tomatoes are twice as rich in this respect as others [187] One of the most important influences which determine the quantity of ascorbic acid in tomatoes is the amount of illumination which the fruit receives at the time of ripening [188] The variation of oranges in respect to their vitamin C content has been the subject of much comment but a group of workers in the Bureau of Home Economics of the United States Department of Agriculture re ported the average ascorbic acid content per cubic centimeter of juice of the different oranges studied to be as follows California Valencia 0 40 mg California navel 0 58 mg Florida Valencia 0 45 mg and Florida pineapple orange 0 51 mg Evidently there is little variation in different growths of oranges and it is safe to assume that a fresh orange contains 40 to 50 mg per 100 cc of juice In their study of the cost of vitamin C as obtained from available foods Holmes Pigott and Tripp[189] found that the cheapest sources in the order named are canned orange juice canned grapefruit juice fresh orange juice and fresh grapefruit juice

Muscle meats are believed to be poor in respect to their vitamin C content, but this belief has been modified somewhat by Stefansson's experiences in the Arctic. This explorer demonstrated that meat will prevent scurvy when eaten raw or rare and taken in sufficient quantity. Liver is greatly superior in this respect to other meats.

Butter, eggs and cheese are said be contain no vitamin C. Mother's milk as a source of this vitamin is much superior to cow's milk, but the latter is nonetheless a good source when consumed raw in generous quantities. The richness of cow's milk in this respect depends not only on the ration, which today is usually suitable, but chiefly on the manner in which the milk is handled. Rasmussen and his associates[190] reported that the average content of this vitamin in milk from Ayrshire, Guernsey and Jersey cows is about the same, but that milk from brown Swiss cows is richer, being 48 per cent richer in this respect than milk from the poorest breed, the Holstein.

Stability. The loss of vitamin C which occurs in drying, canning, cooking, freezing or storing is stated by King[178] to be dependent upon the following unfavorable influences: (*a*) contact with heavy metals, especially copper, (*b*) exposure to air, (*c*) high temperatures, (*d*) disruption of cell structure, (*e*) alkalinity, and (*f*) exposure to light. The influence of the hydrogen ion concentration also, especially as regards tomato juice, is emphasized by Sherman. He reports that tomato juice at its natural acidity of *p*H 4.2 to 4.3 lost only 50 per cent of its vitamin C when heated for one hour at 100° C., whereas when the reaction was changed to *p*H 9 a loss of 65 per cent was noted.

Vegetables lose their potency in this respect when permitted to stand at room temperature. Cabbage loses about 25 per cent of its vitamin C when stored a month at room temperature, while at lower temperatures the loss is materially less. Spinach loses 50 per cent of its value in this respect when wilted after standing a few days, which is not true if it is kept in a refrigerator. Freezing is accompanied by very little loss in this respect, but if the thawing is slow or if the food is not cooked promptly, the loss may be great. The blanching of foods prior to freeze-preserving decreases the loss of ascorbic acid.

The loss which often takes place in milk is due largely to oxidation; this is increased by prolonged exposure to heat, light and air and also by the presence of certain catalytic metals, notably copper. The boiling of milk in an open container may result in the loss of as much as half its vitamin C. Dried milk, however, prepared by the roller or the spray process, is reported to retain a good part of its ascorbic acid because of the rapid drying of each particle. King and Waugh[191] demonstrated that pasteurization need not appreciably lessen the vitamin C content of cow's milk and that it is possible today to take such precautions as will permit the production of pasteurized milk which in respect to its vitamin C content is of standard richness. On the other hand, Bessey[187] warns that the vitamin C content of commercial milk, raw or pasteurized, is not dependable and should never be relied upon to supply the requirements. He believes that most commercial preparations of dry milk are practically devoid of this vitamin.

### VITAMIN P

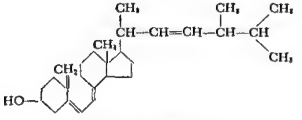
The concept of vitamin P is ill defined and even the existence of such a nutritional factor is controversial [192] A clear description of a deficiency syndrome attributable to lack of this factor has not been provided for man or animals

It has been both claimed and denied that the survival of scorbutic guinea pigs is prolonged by giving sources of this evasive factor The factor is supposedly of value in elevating capillary resistance in a variety of unrelated clinical syndromes but as Scarborough and Bacharach[193] caution, much of this work is discredited because of a lack of adequate control periods and groups insufficient numbers of subjects and unreliable methods and preparations used Furthermore there is no evidence for subsistence of these patients on a deficient diet

Supposedly active preparations of this material do not elevate the capillary resistance in thrombocytopenic purpura and the reports of effectiveness are conflicting in instances of low capillary resistance associated with diabetes or hypertension Perhaps the most convincing claim for effectiveness of some of these substances is in their protective action in experimental irradiation injury[194] in dogs and rats

The evidence may be fairly summarized by stating that a group of derivatives (including hesperidin and rutin) of 2 phenyl 1 4 benzopyrone is claimed to influence capillary resistance in some unrelated diseases but the validity and importance of these effects cannot be assessed There is no convincing evidence that the effect if it exists can be related to lack of a dietary essential instead it would seem that the effect may be attributed to a pharmacologic property of the chemical

### VITAMIN D




Calciferol (vitamin $D_2$)

The disturbance in bone development characteristic of rickets was produced in dogs by Mellanby and shown to be related to the anti calcifying effect of some cereals The effect could be counteracted by a fat soluble factor which was later separated by McCollum[196] in 1922 from fat soluble A

Vitamin D was first known through its presence in cod liver oil and other foods In their search for the active substance Hess[197] and Steenbock [198] working independently made the simultaneous discovery that ultraviolet irradiation will give to certain foods antirachitic properties It was found that cereals meat milk eggs fats oils various vegetables and many other foods could be endowed with these properties It was evident that each of the foods so treated contained an activatable sub-

stance or provitamin The substance exhibited the properties of a sterol, and it was found that ergosterol could be activated by *irradiation with* light of the wavelength 310 to 250 millimicrons The active irradiation product, calciferol, was later shown to be but one of many vitamins D Calciferol is now known as vitamin $D_2$, activated 7 dehydrocholesterol the naturally occurring vitamin from cod, tuna, and halibut liver oils is termed vitamin $D_3$ A number of other structurally similar compounds have been produced which have antirachitic potency[199 200] Vitamins $D_3$ and $D_2$, however, are the medically important substances

Vitamin D is relatively stable, so that loss in foodstuffs is of minor concern

**Physiology of Vitamin D** Vitamin D, as a lipid soluble factor, is absorbed in association with fats Hence impairment of fat absorption may be associated with the development of avitaminosis D Such an influence may *be observed in celiac disease, sprue, idiopathic steatorrhea, and other* such conditions Mineral oil reduces the effectiveness of vitamin D[206a]

*In common with other fat soluble vitamins* the capacity of the body for storage of this factor is great This fact probably accounts for the *infrequency of evidences of deficiency in the adult and the age distribution* of rickets coincident with the period of rapid growth and before an age at *which body stores of the vitamin accumulate readily*

Vitamin D functions to improve calcium and phosphorus utilization This effect is mediated *primarily through improvement in* the net absorption of these minerals The interrelationships of calcium, phosphorus, vitamin D, the parathyroid glands the gut and kidneys, according to Albright and Reifenstein,[201] may be summarized as follows The administration of vitamin D increases calcium absorption from the gut with a resulting rise in serum calcium This latter depresses the activity of the parathyroid gland, which then reduces the urinary excretion of phosphorus The decreased urinary excretion of phosphorus may not always follow vitamin D dosage, for vitamin D is believed by Albright to have a second and independent action—viz, to increase the renal excretion of phosphorus In the treatment of rickets and osteomalacia, however, this second action is not of primary importance

The impressive amount of evidence for the decalcifying effect of cereal phytate has been summarized *by Mellanby*[195] *He showed that* vitamin D enhances the activity of the phytate destroying enzyme, phytase *Whether this is the only action of vitamin* D in the absorption of calcium is doubtful, but it seems to be the best documented mechanism *to date* Whether the vitamin exerts a direct effect upon calcification cannot be stated It is of interest, however, that the rate of exchange of bone calcium with dietary calcium is decreased in rachitic animals as measured by use of radioactive calcium[202] Evidence has been presented to indicate that phosphorylated vitamin D activates alkaline phosphatase[202a]

**Potency.** The relative potency of vitamin D obtained from different sources has been held to vary The antirachitic properties of *viosterol* are due to its contained calciferol ($D_2$), while the potency of cod liver oil and other fish oils comes largely from *vitamin $D_3$* *Viosterol*, rat unit

for rat unit, is less effective in curing rickets in chickens than is cod liver oil. For human beings Hess and his associates[203] found that 1 rat unit of cod liver oil had the same effectiveness as 4 rat units of viosterol and that in the treatment of human rickets, rat unit for rat unit, the milk from cows fed irradiated yeast was five times as effective as viosterol and somewhat more effective than cod liver oil.

Such differences in potency have not been found by other investigators. Jeans and Stearns[204] found no difference in promotion of calcium and phosphorus retention between vitamin $D_2$ and $D_3$ when these were administered to controlled normal infants. Jeans concludes that, "It seems logical to believe that if no differences are found in calcium and phosphorus retentions, no differences exist for man between the two forms of the vitamin."

Sunlight or artificial ultraviolet radiation will substitute for ingested vitamin D. The actinic rays from these sources acting on the skin convert the provitamin into vitamin D. These rays do not pass in effective amounts through ordinary window glass, and they are easily diverted by dust and smoke in the atmosphere.

**The International Standard.** Originally the international standard of vitamin D was a solution of irradiated ergosterol in olive oil of such potency that 1 unit equaled the activity of 0.025 microgram of the crystalline vitamin. In 1949 the standard was redefined as vitamin $D_3$, a unit still the equivalent of 0.025 microgram of the vitamin (i.e., 1.0 mg = 40,000 I.U.). The USP unit and the international unit are similarly defined and may be taken as equivalent for clinical purposes despite some disagreement as to exact equivalence of the reference oil.

**Hypervitaminosis D.**[201,206,207] The toxic picture of hypervitaminosis D results from a prolonged, greatly excessive intake of the vitamin. Vitamin D poisoning has been associated with ingestion of 100,000 I.U. or more of D per day in adults and with 20,000 to 40,000 I.U. to infants. The syndrome is characterized by anorexia, nausea, vomiting, diarrhea (sometimes bloody), lassitude, weakness, drowsiness, headache and weight loss. Polyuria, nocturia and dysuria may occur. Pruritus and an exfoliative dermatitis, as well as abnormal pigmentation, have been noted. Periarticular calcification may be found upon physical examination. Metastatic calcification of renal, prostatic and vascular structures may be found. The serum calcium concentration is elevated, and the laboratory findings reveal the expected evidences of renal damage—proteinuria, casts, elevated nonprotein nitrogen level, and impaired renal function tests. Therapy consists in interdiction of the excessive vitamin D intake, a low calcium diet, and, if there is hyperphosphatemia, a low phosphorus intake.

**Requirement.** Man's requirement for vitamin D is difficult to determine accurately, because through exposure to the sun he normally manufactures large quantities in his skin. In addition, as Jeans and Stearns[209] remark, such determinations presuppose a diet adequate in all other respects. This applies particularly to the intake of calcium and phosphorus. The administration of this vitamin, notably in pregnancy and lactation, does not obviate the necessity for an adequate intake of these

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elements Difference other than mere prevention of clinical rickets must be considered It has been found for example that while infants given fortified milk containing 135 units of vitamin D to the quart experienced average growth those fed milk containing 100 units to the quart exhibited a more rapid growth [209] This principle however, should not be carried to extremes for the admission of vitamin D in excessive amounts may defeat its purpose The authors just quoted tell of a group of five infants who when given 1500 or more units daily, showed decreased appetite and retardation of growth at or beyond six months of age

The need for vitamin D is greatest during periods of rapid growth—infancy, at the time of prepubertal growth acceleration, and adolescence The requirement of adults is uncertain, but it appears that 400 units should satisfy any needs

The recommended daily allowance of the Food and Nutrition Board is 400 I U for all ages of children and for women during pregnancy and lactation Regarding adults the Board states 'The need for supplemental vitamin D by vigorous adults leading a normal life seems to be minimum For persons working at night and for nuns and others whose habits shield them from the sunlight as well as for elderly persons the ingestion of small amounts of vitamin D is desirable'

Sources The food sources of vitamin D are meager According to Nelson[210] there is no proof that vitamin D is present in living plant tissues and fresh green vegetables should be regarded as devoid of antirachitic potency The natural foods which carry this vitamin are of animal origin, among which fish come first, notably those fish which contain much body oil such as salmon sardines and herring Milk provides vitamin D in appreciable amounts Summer milk is the more valuable in this respect because the cows are exposed to the sun s rays Eggs contain an appreciable amount of vitamin D, which under favorable conditions is reported to be as much as 390 units per 100 gm of yolk, but this is not always a dependable source Liver also has some value in this respect Such foods taken in liberal amounts may form significant sources of vitamin D

Table 20 Distribution of Vitamin D in Various Fish Oils (Bills[211])

| Source of Oil | Potency I U per Gram |
|---|---|
| Bluefin tuna liver | 40 000 |
| Swordfish liver | 10 000 |
| Yellowfin tuna liver | 10 000 |
| Black sea bass liver | 5 000 |
| Bocaccio liver | 2 100 |
| Red rockfish liver | 1,500 |
| Black rockfish liver | 1,500 |
| China rockfish liver | 1 400 |
| Ling cod (not codfish) liver | 1 300 |
| Chinook salmon liver | 1,300 |
| Halibut liver | 1,200 |
| Rabbitfish liver | 1 100 |
| Striped rockfish liver | 1 000 |
| Starry flounder, liver | 1 000 |

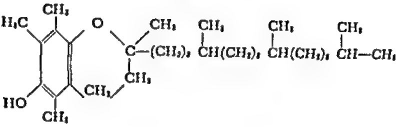
| | |
|---|---|
| Boston mackerel liver | 750 |
| Black cod (not codfish) liver | 600 |
| Pufferfish liver | 570 |
| Dog salmon liver | 400 |
| Black horse mesentery | 400 |
| Turbot liver | 260 |
| Rex sole liver | 150 |
| California sand dab liver | 120 |
| Cod liver | 100 |
| Herring entire body | 100 |
| Yellow sole liver | 90 |
| Sardine entire body | 80 |
| Goosefish liver | 70 |
| Pollock liver | 50 |
| Menhaden entire body | 50 |
| Shark liver | 50 |
| Salmon trimmings | 40 |
| Turbot body minus liver | 30 |
| Skate liver | 25 |
| Dogfish (Pacific) liver | 20 |
| Muddy catfish body | 20 |
| Ohio perch mesentery | 11 |
| Buffalo mesentery | 10 |
| Haddock liver | 10 |
| Channel catfish mesentery | 5 |
| Dogfish (Atlantic) liver | 3 |
| Capelin entire body | 3 |
| Ratfish liver | 2 |
| Gray sole liver | <1 |
| Sturgeon liver | nil |

The pharmaceutic preparations of vitamin D do not come within the scope of this book but since such preparations must be used as food auxiliaries they require mention These preparations are derived from natural fish oils or from irradiated sterols Cod liver oil U S P is required to contain at least 85 units of vitamin D per gram or approximately 312 units per teaspoonful Viosterol in oil must contain at least 10 000 units of vitamin D to the gram New preparations of varying strengths are constantly being offered The physician must familiarize himself with the potency of a preparation which he intends to prescribe

Vitamin D was the first vitamin to be added to foodstuffs for purposes of fortification Many considerations were involved in developing the program of addition of vitamin D to foods The wisdom of the conservative course chosen, restriction of vitamin D addition to milks and bread is now apparent from our knowledge of hypervitaminosis D It is obvious that chaos could have resulted if the addition of D to all types of foods had been allowed

Milk fortified with 400 units of vitamin D per quart (or reconstituted quart in processed milks) is widely available A quart of such milk supplies enough vitamin D to meet the recommended allowances of the Food and Nutrition Board When homogenized vitamin D added milk or evaporated milk with vitamin D added is used in infant feeding additional supplements of this vitamin are superfluous wasteful and may even be mildly toxic

## VITAMIN E



α Tocopherol

Vitamin E was discovered by Evans and Bishop[212] when they found that rats reared on a basic ration of casein, cornstarch, lard, butter fat yeast and an appropriate salt mixture will attain maturity in the normal manner, but will fail to reproduce. The sexual cycle in the female is normal, *and she conceives in an apparently normal manner*, but about the twelfth or thirteenth day the fetus dies, and a little later both fetus and placenta are absorbed. Evans assumed, and the correctness of this assumption has been amply proved by others,[213] that this reproductive disturbance is due to the lack of a specific nutritive factor distinct from any hitherto described. This factor is called vitamin E.

The chemical nature of this substance was determined by Evans, Emerson, and Emerson[214] when they isolated from wheat germ oil a highly potent alcohol having the properties attributed to vitamin E, to which the class name 'tocopherol' was given. Four tocopherols are now recognized.[214] These are chemically similar α, β, γ, δ tocopherol. All are anti-oxidants.

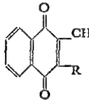
There are excellent macro-[215] and micro-[216] methods for the determination of total tocopherols in biological fluids and for the estimation of the separate tocopherols.[217] These methods have enabled the accumulation of information on the distribution of tocopherols in foods,[218] *human tissues*,[219] *and the variations in plasma concentration* in health and disease.[220]

The richest dietary sources of tocopherols are certain vegetable *oils*. Unrefined cereals and eggs are second in their contributions to the diet. Vegetables, meats, and dairy products are poor sources of the factor.[218] It has been estimated that the average per capita consumption of tocopherol is about 24 mg. a day, 59 per cent of which is α tocopherol. This intake suffices to maintain plasma levels[220] of total tocopherols of 0.5 to 1.5 mg. per 100 ml. in healthy adult subjects. Low levels are seen in newborns, in patients with absorptive defects, steatorrhea, and liver disease. High values occur in normal pregnancy, in some diabetics, in xanthomatous states, and in various *diseases characterized* by hypercholesterolemia.[232] Tissues from two human subjects[219] contained a total of 2.3 and 6.6 gm. of tocopherol, respectively, for a male and a female. The primary site of storage was the fatty tissue.

It is obvious that vitamin E is regularly consumed by the human being, that it is absorbed in a fashion similar to the other fat soluble vitamins, and that it is stored in the human body. Despite this, no convincing instance of avitaminosis E in man has yet been reported.

In experimental animals[221-224] a deficiency of tocopherols may lead to sterility, abortion, the development of a muscular dystrophy,[230] cardiac failure,[231] encephalomalacia and the abnormal excretion of a pentose[229] and of creatine in the urine Despite the fact of similar diseases in man none of these analogous syndromes respond to vitamin E although favorable claims are many Too many of the reports on the clinical effectiveness of tocopherols are lacking in controls and other evidences of critical design Contrary to widely publicized claims, vitamin E is not useful in the treatment of diabetes[225] coronary artery disease habitual abortion,[226] sterility, muscular dystrophy[227-228] or dermatologic conditions Definition of the role of tocopherols in human nutrition and disease awaits the future

## VITAMIN K



R = H = 2 methyl 1 4 naphthoquinone
R = phytyl = vitamin $K_1$
R = difarnesyl = vitamin $K_2$

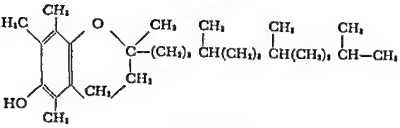
Vitamin K,[233] isolated in 1939 is found in two closely similar forms $K_1$, a phytyl derivative, isolated from alfalfa and $K_2$ a difarnesyl derivative, isolated from putrefied fish meal Numerous compounds with biological activity are now known All of these contain the naphthoquinone ring or present the possibility of conversion into such a compound The simplest and most active compound is menadione, 2 methyl 1,4 naphthoquinone[234]

Function Vitamin K is essential for the formation of prothrombin by the liver A deficiency of vitamin K produces hypoprothrombinemia and thereby reduces the coagulability of blood and increases the tendency to bleed All the clinically useful methods for assessing vitamin K status are based on prothrombin estimations Both the one stage and the two stage methods have their advocates but either may be profitably applied in the assessment of a patient However hypoprothrombinemia is sometimes due to hepatic injury and is not always a sign of avitaminosis K Indeed the failure of hypoprothrombinemia to respond to vitamin K can be a useful liver function test[235]

Vitamin $K_2$ arises from bacterial action and the vitamin may be synthesized by the intestinal flora as is indicated by the appearance of hypoprothrombinemia in sulfa fed rats[236] It has been suggested that a change in gastrointestinal flora with loss of this source of vitamin K may account for the hypoprothrombinemia sometimes observed in infants with chronic diarrhea[237] In the newborn infant the prothrombin concentration is often low until several days after birth by which time a gastrointestinal flora is established The hypoprothrombinemia of the newborn can be reduced by the administration of vitamin K to the mother prior to delivery[238] or to the infant at birth

Vitamin K is fat soluble, when lipid absorption is impaired the body

## VITAMIN E



α Tocopherol

Vitamin E was discovered by Evans and Bishop[212] when they found that rats reared on a basic ration of casein, cornstarch, lard, butter fat, yeast and an appropriate salt mixture will attain maturity in the normal manner, but will fail to reproduce. The sexual cycle in the female is normal, and she conceives in an apparently normal manner, but about the twelfth or thirteenth day the fetus dies, and a little later both fetus and placenta are absorbed. Evans assumed, and the correctness of this assumption has been amply proved by others,[213] that this reproductive disturbance *is due to the lack of a specific nutritive factor distinct from* any hitherto described. This factor is called vitamin E.

The chemical nature of this substance was determined by Evans, Emerson, and Emerson[214] when they isolated from wheat germ oil a highly potent alcohol having the properties attributed to vitamin E, to which the class name 'tocopherol' was given. Four tocopherols are now recognized.[214] These are chemically similar α, β, γ, δ tocopherol. All are anti-oxidants.

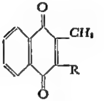
There are excellent macro-[215] and micro-[216] methods for the determination of total tocopherols in biological fluids and for the estimation of the separate tocopherols.[217] These methods have enabled the accumulation of information on the distribution of tocopherols in foods,[218] human tissues,[219] and the variations in plasma concentration in health and disease.[220]

The richest dietary sources of tocopherols are certain vegetable oils. Unrefined cereals and eggs are second in their contributions to the diet. Vegetables, meats and dairy products are poor sources of the factor.[218] It has been estimated that the average per capita consumption of tocopherol is about 24 mg. a day, 59 per cent of which is α tocopherol. This intake suffices to maintain plasma levels[220] of total tocopherols of 0.5 to 1.5 mg. per 100 ml. in healthy adult subjects. Low levels are seen in newborns, in patients with absorptive defects, steatorrhea, and liver disease. High values occur in normal pregnancy, in some diabetics, in xanthomatous states, and in various diseases characterized by hypercholesterolemia.[232] Tissues from two human subjects[219] contained a total of 2.3 and 6.6 gm. of tocopherol, respectively, for a male and a female. The primary site of storage was the fatty tissue.

It is obvious that vitamin E is regularly consumed by the human being, that it is absorbed in a fashion similar to the other fat soluble vitamins, and that it is stored in the human body. Despite this, no convincing instance of avitaminosis E in man has yet been reported.

In experimental animals[221, 224] a deficiency of tocopherols may lead to sterility, abortion the development of a muscular dystrophy[230] cardiac failure[231] encephalomalacia and the abnormal excretion of a pentose[229] and of creatine in the urine Despite the fact of similar diseases in man none of these analogous syndromes respond to vitamin E although favorable claims are many Too many of the reports on the clinical effectiveness of tocopherols are lacking in controls and other evidences of critical design Contrary to widely publicized claims vitamin E is not useful in the treatment of diabetes[225] coronary artery disease habitual abortion[226] sterility, muscular dystrophy[227, 228] or dermatologic conditions Definition of the role of tocopherols in human nutrition and disease awaits the future

## VITAMIN K



R = H = 2 methyl 1 4 naphthoquinone
R = phytyl = vitamin $K_1$
R = difarnesyl = vitamin $K_2$

Vitamin K[233] isolated in 1939 is found in two closely similar forms $K_1$ a phytyl derivative isolated from alfalfa and $K_2$ a difarnesyl derivative isolated from putrefied fish meal Numerous compounds with biological activity are now known All of these contain the naphthoquinone ring or present the possibility of conversion into such a compound The simplest and most active compound is menadione 2 methyl 1 4 naphthoquinone[234]

Function Vitamin K is essential for the formation of prothrombin by the liver A deficiency of vitamin K produces hypoprothrombinemia and thereby reduces the coagulability of blood and increases the tendency to bleed All the clinically useful methods for assessing vitamin K status are based on prothrombin estimations Both the one stage and the two stage methods have their advocates but either may be profitably applied in the assessment of a patient However hypoprothrombinemia is sometimes due to hepatic injury and is not always a sign of avitaminosis K Indeed the failure of hypoprothrombinemia to respond to vitamin K can be a useful liver function test[235]

Vitamin $K_2$ arises from bacterial action and the vitamin may be synthesized by the intestinal flora as is indicated by the appearance of hypoprothrombinemia in sulfa fed rats[236] It has been suggested that a change in gastrointestinal flora with loss of this source of vitamin K may account for the hypoprothrombinemia sometimes observed in infants with chronic diarrhea[237] In the newborn infant the prothrombin concentration is often low until several days after birth by which time a gastrointestinal flora is established The hypoprothrombinemia of the newborn can be reduced by the administration of vitamin K to the mother prior to delivery[238] or to the infant at birth

Vitamin K is fat soluble when lipid absorption is impaired the body

may find itself in short supply of the vitamin Thus a bleeding tendency may develop in obstructive jaundice, biliary fistula, sprue celiac disease Whipple's disease, pancreatic disease, and like conditions The impairment of absorption and changes in the synthetic ability of the gastrointestinal flora are more important in maintaining the supplies of the vitamin than are foods Indeed, vitamin K deficiency has not been induced in man by dietary restriction

*It is apparent from this brief discussion* that a dietary requirement of the vitamin cannot be set

Dicumarol [239] Dicumarol, 3, 3' methylene bis (4 hydroxycoumarin) is the compound present in spoiled sweet clover hay and is responsible for the hypoprothrombinemia which occurs in cattle eating the spoiled hay This compound is used in medicine because of its property of reducing the prothrombin formation in the hope that intravascular clotting may be prevented It is outside the scope of this discussion to evaluate this agent Suffice it to point out that vitamin K does not reverse the effect of Dicumarol immediately Vitamin $K_1$ oxide,[240] a water dispersible substance and emulsified $K_1$ intravenously[241] bring about more rapid reduction of prothrombin times prolonged by Dicumarol

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# 6

## *Inorganic Nutrients*

The inorganic elements of demonstrated importance to man include calcium phosphorus iron iodine fluorine sodium and potassium Deficiencies of these elements or beneficial effects of their ingestion have been observed in the human being In addition certain other elements such as copper zinc and cobalt occur as moieties in biological systems important to man These elements are presumably of dietary importance but dietary deficiencies of them have not been demonstrated in the human being

The mineral elements serve a great variety of functions in the body The chief structural component lending rigidity to bones is a salt of calcium and phosphorus Indeed some 99 per cent of the body s calcium is to be found in the bones and appears to serve primarily a structural function On the other hand phosphorus is found as a component of the phospholipids which are exceedingly active metabolic substances Iodine is contained in thyroxin the active principle of the thyroid gland Many of the trace elements serve as necessary components of enzyme systems

The trace elements deserve special mention since they are discusssd with increasing frequency The exact group of substances embraced by the term trace element varies with the writer The general properties of these elements however were well pointed up by Sir Joseph Barcroft[1] as follows (*a*) A trace element is usually a metallic element fluorine and iodine being exceptions (*b*) It is a normal constituent of the animal or plant (*c*) It must be present in the right amount and mischief arises in some cases if there is too much as with molybdenum or in other cases because there is too little as with cobalt Trace element diseases are not necessarily deficiency diseases (*d*) A trace element is present in not more than one part in twenty thousand of the organism approximately the proportion in which zinc and iron are present in the tissues of man (*e*) The action of the trace element is essentially that of an enzyme

The occurrence of deficiencies of trace elements in herbivora has fired the imagination of many as to the possibility of similar deficiencies occurring in man While it is true that deficiencies of certain of the trace elements do occur in man notably a deficiency of iodine it is not permissible to reason that deficiencies must be manifest in man similar to those found in animals Several factors help protect man against the

development of deficiencies of trace elements. Thus foodstuffs of animal origin are of relatively constant composition.[5] Indeed rigid restriction in an essential nutrient prohibits the growth of an animal. Since the human being frequently includes a variety of animal products in his diet, and in these products a concentration of scarce elements has already occurred, it is apparent that it might be difficult for man to exhibit a trace element deficiency. Despite the considerable amount of loose and uncritical discussion of trace elements and their deficiency in man, particularly as related to the quantity of these elements present in soil, it may be fairly stated that, with the exception of iodine, no acceptable evidence has appeared for the occurrence of a deficiency of trace elements in man attributable to a lack of them in the soil.

## IRON[5,6]

Iron is present in foodstuffs in a number of forms, certain of which are but slightly absorbed. The poor absorbability of the metal is due in some instances to its combination in a sparingly soluble compound or in an organic form which is liberated with difficulty. In other instances, differences in the absorbability of iron are based on differences in the valence states of the metal. This is particularly true of pharmaceutical preparations.

Studies on the availability of iron indicate important species differences.[7] Accordingly, results of investigations in animals cannot be transferred directly to man. For studies in the human being, the most fruitful types of investigation have been those using the metabolic balance technic and radioactive iron. The principle of this latter type of investigation is as follows. The desired quantity (usually small and within the physiologic range) of iron is administered. This iron is tagged by the presence in the sample of a radioactive isotope of iron. Subsequently, at intervals, blood, excreta or tissues are sampled and ashed, and determinations made of the radioactivity of the iron contained in these substances. Thus one determines the distribution of the atoms of iron which were administered and is able thereby to distinguish the actual administered iron from that which may arise from sources within the body.

**Absorption.** Investigations in man using labeled samples of iron salts indicate that the absorption of salts of iron from the gastrointestinal tract is normally a controlled process.[8] The healthy nondeficient adult will absorb but a small portion of ingested iron.[9] The iron deficient person absorbs a great deal more iron from the gastrointestinal tract than does the healthy person. Studies in growing children indicate that the efficiency of the absorption process parallels the need for the element.[10] Similarly, during the latter part of pregnancy the absorptive efficiency is considerably increased, this increase occurring during the time the fetal iron stores are built up.[11]

Recent investigations by Moore and Dubach[12] seem to indicate that the absorption of iron from foods may differ from the absorption of inorganic iron salts. These investigators incorporated radioactive iron into eggs, chicken muscle, chicken and rabbit liver, mustard greens and … from these foods has been

tested in healthy human subjects and in those with anemias It was found that fourteen of sixteen healthy subjects absorbed less than 10 per cent of the iron from these foodstuffs Iron deficient subjects did not exhibit a more efficient absorption of the element from the foodstuffs Ascorbic acid and foods containing this vitamin enhanced the absorption of food iron Alterations in acidity either by the addition of hydro chloric acid or by the simultaneous administration of antacids were without effect upon absorption of the element

It is possible that some of the reported differences in the absorption of food iron and iron salts may be due to a masking of small differences by the effect of food bulk Thus Sharpe Harris Peacock and Cooke[13] observed that the simultaneous ingestion of food decreased the efficiency of absorption of iron by man and attributed this effect in part to the bulk of the foods

Ferrous iron is more efficiently absorbed than is ferric[7,15] It seems probable that all iron which is absorbed must first be reduced to the ferrous state Therefore the presence of a reducing substance or sub stances in the gastric juice is of functional importance in the absorption of iron[16] Indeed at least a portion of the enhancement of iron absorp tion by ascorbic acid can be attributed to the reducing effect of the ascorbic acid

Granick[17] postulated that the control of iron absorption of the gastro intestinal mucosa may be mediated through the iron containing protein *ferritin* This protein which in its iron free form is termed apoferritin may incorporate up to 23 per cent of its weight of iron Ferritin is known to serve as a repository for iron in the body

Storage Iron is transported in the plasma in the ferric state in one of the globulin fractions[18] Serum iron normally ranges from approxi mately 80 to 180 micrograms per 100 milliliters Lower than normal values are encountered in hypochromic microcytic anemia of iron de ficiency and in the anemia of infection In the first instance the low values are due to iron deficiency in the second instance to a reduced capacity to carry iron (or a reduction in the iron binding capacity of the serum) In pernicious anemia higher than normal values are found in the serum

Iron is present in the tissues in a variety of compounds The storage iron is present as a readily available labile pool of iron[19] composed of recently absorbed iron plus that recently released from the breakdown of hemoglobin and as a more fixed less readily available tissue iron The chief sites of iron storage are the liver spleen bone marrow and kidneys In addition to storage iron the tissues contain so-called parenchymal iron —a relatively fixed iron present in muscle and other tissues in the iron containing enzymes such as cytochrome catalase and the like In addition iron is present in the tissues as muscle hemo globin Parenchymal iron and muscle hemoglobin were termed by Hahn[9] as inviolate stores of iron which are not drawn on no matter how great the emergency due to anemia

A surprisingly small loss of iron from the body occurs each day[8,9] Practically no iron is excreted in the urine and the excretory iron in

the feces comprises less than 1 mg. daily. Although it has been claimed that considerable quantities of iron are lost in perspiration,[20] Moore[21] has failed to confirm these findings.

**Requirement.** Numerous estimates of iron requirements have been made. The difficulties of study and the great tendency of the body to conserve the element make the setting of minimal allowances for adults nearly meaningless. Moore and Dubach[12] have reasoned that the normal adult male must assimilate between 0.5 and 1.0 mg. of iron per day in order to maintain iron balance, while the normal adult woman probably requires 1.0 to 1.5 or 2.0 mg of assimilated iron per day. Thus, if but 10 per cent of the food iron is absorbed, it would appear that 12 to 15 mg per day should be ingested in order to maintain this balance. Indeed, this is the level of intake for adults suggested by the recommended daily dietary allowances (see p. 208). For children, the recommended daily dietary allowances range from 6 mg. daily under one year of age to 15 mg. daily for children during adolescence.

**Sources.** Important dietary sources of iron are eggs, organ meats, legumes, leafy green vegetables, whole grain cereals, enriched cereals, lean meats, and molasses.

Table 21. Iron in Typical Foods (Edible Portion) (Sherman)

| Food | Iron per 100 Gm Fresh Substance Milligrams | Iron per 100 Gm of Protein Milligrams | Iron per 3000 Calories Milligrams |
|---|---|---|---|
| Apples | 0.3 | 100 | 14 |
| Bananas | 0.6 | 50 | 18 |
| Beans, dried | 10.3 | 47 | 90 |
| Beans, snap or string | 1.1 | 46 | 78 |
| Beef, all lean | 3.0* | 13 | 80* |
| Beefsteak, medium fat | 2.0* | 13 | 43* |
| Carrots | 0.7 | 58 | 47 |
| Eggs | 3.1 | 24 | 60 |
| Egg yolk | 8.7 | 53 | 73 |
| Kale | 2.5 | 64 | 151 |
| Oatmeal | 5.2 | 37 | 39 |
| Oranges | 0.3 | 33 | 18 |
| Peas, dried | 6.0 | 25 | 52 |
| Potatoes | 1.1 | 55 | 39 |
| Prunes, dried | 3.5 | 152 | 35 |
| Tomatoes | 0.6 | 60 | 79 |
| Wheat, entire | 5.7 | 51 | 48 |

* Figures for meats can be only rough approximations because of variations in fatness as well as differences between different cuts. Forbes and Swift report that organs contain more iron than muscle meats, while pork and lamb contain *much* less than beef.

(From Sherman, H. C.: Chemistry of Food and Nutrition. By permission of The Macmillan Co., Publishers.)

**Iron Deficiency.** Iron deficiency may be either dietary or conditioned in origin. A dietary lack of iron is unlikely to be encountered in the adult. It is, however, the common cause of iron deficiency in infants,

**Table 22 Copper Content of Foods (Edible Portion)**
(Lindow, Elvehjem and Peterson[93])

| Food | Copper Content: Dry Basis (100°) (Mg per Kg) | Copper Content: Fresh Material (Mg per Kg) |
|---|---|---|
| Almonds | 12.6 | 12.1 |
| Apples, greening | 4.6 | 0.8 |
| Apples, snow | 7.5 | 1.2 |
| Apricots, dried | 6.2 | 3.7 |
| Artichoke | 20.1 | 3.1 |
| Asparagus | 17.2 | 1.4 |
| Bananas | 8.5 | 2.1 |
| Beans, Kidney | 7.4 | 6.5 |
| Beans, Lima | 9.8 | 8.6 |
| Beans, navy (2) | 8.0 | 6.9 |
| Beans, String | 12.0 | 1.0 |
| Beef brains | 12.0 | 2.1 |
| Beef casings | 8.4 | 1.6 |
| Beef kidney | 6.0 | 1.1 |
| Beef liver (5) | 75.7 | 21.5 |
| Beef lung | 11.4 | 2.2 |
| Beef pancreas | 4.0 | 0.8 |
| Beef spleen | 6.0 | 1.4 |
| Beefsteak, round | 3.0 | 0.8 |
| Beefsteak, T bone | 1.7 | 1.2 |
| Beet greens, tops | 9.3 | 0.9 |
| Beet greens, roots | 7.7 | 1.0 |
| Beets (2) | 11.5 | 1.9 |
| Blackberries | 10.0 | 1.6 |
| Blackcaps | 8.0 | 1.4 |
| Blueberries | 6.0 | 1.1 |
| Bran Flakes | 6.2 | 5.8 |
| Brazil nuts | 14.8 | 13.9 |
| Bread, white | 5.2 | 3.4 |
| Brussels sprouts | 8.2 | 1.0 |
| Butternuts | 12.1 | 11.7 |
| Cabbage | 6.8 | 0.5 |
| Calf brains | 7.5 | 1.8 |
| Calf liver (6) | 164.4 | 44.1 |
| Cantaloupe | 6.1 | 0.6 |
| Carrots | 8.1 | 0.8 |
| Cauliflower | 16.5 | 1.4 |
| Celery | 2.0 | 0.1 |
| Celery cabbage | 10.4 | 0.6 |
| Chard | 13.2 | 1.1 |
| Cheese, American | 2.6 | 1.8 |
| Cheese, Swiss | 2.0 | 1.3 |
| Cherries, red | 11.7 | 1.4 |
| Chestnuts, Italian | 9.2 | 6.0 |
| Chocolate, bitter | 27.2 | 26.7 |
| Cocoa | 35.0 | 33.4 |

| Food* | Copper Content: Dry Basis (100°) (Mg per Kg) | Copper Content: Fresh Material (Mg per Kg) |
|---|---|---|
| Cocoanut | 11.4 | 6.9 |
| Corn, sweet, bantam | 5.9 | 0.6 |
| Corn, sweet, evergreen | 6.8 | 1.1 |
| Corn Flakes | 2.0 | 1.9 |
| Corn meal, white, prepared | 2.0 | 1.9 |
| Corn meal, yellow, prepared | 2.1 | 2.0 |
| Cranberries | 7.8 | 0.9 |
| Cream of Wheat | 3.1 | 2.9 |
| Cucumbers | 17.8 | 0.6 |
| Currants | 16.6 | 11.2 |
| Dandelion greens | 13.1 | 1.5 |
| Dates, dried | 5.3 | 3.8 |
| Eggs | 8.2 | 2.3 |
| Egg yolk | 8.0 | 4.0 |
| Eggplant | 13.6 | 1.0 |
| Figs, dried | 5.7 | 3.5 |
| Fish and sea foods | | |
| Bass | 6.2 | 1.4 |
| Bluefish | 10.0 | 2.3 |
| Catfish | 8.4 | 1.7 |
| Codfish | 29.8 | 5.5 |
| Flounder | 7.3 | 1.5 |
| Haddock | 13.4 | 2.8 |
| Halibut | 7.1 | 2.3 |
| Herring | 11.1 | 2.5 |
| Lobster | 38.8 | 7.3 |
| Mackerel | 15.4 | 3.4 |
| Oyster (2) | 245.8 | 30.7 |
| Perch | 18.7 | 3.7 |
| Pickerel | 12.3 | 3.4 |
| Pike | 8.5 | 1.7 |
| Red snapper | 7.6 | 1.6 |
| Salmon | 7.8 | 1.9 |
| Scallops | 12.3 | 2.3 |
| Shad | 7.7 | 2.3 |
| Shrimp | 14.4 | 1.3 |
| Trout, lake | 10.3 | 3.3 |
| Whitefish | 9.7 | 1.9 |
| Flour, buckwheat | 7.7 | 7.0 |
| Flour, Graham | 5.2 | 4.9 |
| Flour, patent | 1.9 | 1.7 |
| Flour, rye | 4.4 | 4.2 |
| Gooseberries | 8.1 | 0.8 |
| Grapes, Malaga | 4.8 | 0.9 |

* When more than one sample was analyzed, the number of samples is indicated by the figure in parentheses.

Table 22 Copper Content of Foods (Edible Portion) (Continued)
(Lindow Elvehjem and Peterson[93])

| Food | Copper Content: Dry Basis (100°) (Mg per Kg) | Copper Content: Fresh Material (Mg per Kg) | Food* | Copper Content: Dry Basis (100°) (Mg per Kg) | Copper Content: Fresh Material (Mg per Kg) |
|---|---|---|---|---|---|
| *Grapefruit* | 4.8 | 0.3 | *Potatoes* | 8.0 | 1.7 |
| Grape juice | 5.3 | 0.2 | Potatoes sweet | 5.2 | 1.5 |
| Hazelnuts | 14.0 | 13.5 | Poultry | | |
| Hickory nuts | 11.7 | 14.3 | Chicken dark meat | 12.7 | 4.1 |
| Hog liver (5) | 20.8 | 6.5 | Chicken white meat | 11.5 | 2.7 |
| Hominy | 2.0 | 1.9 | Duck | 7.3 | 4.1 |
| Honey | 2.5 | 2.0 | Goose | 7.7 | 3.3 |
| Kohlrabi | 15.0 | 1.4 | Turkey dark meat | 7.3 | 2.0 |
| Kumquats | 5.5 | 0.8 | Turkey white meat | 5.4 | 1.5 |
| *Lamb chops* | 9.1 | 4.2 | *Prunes dried* | 7.3 | 4.1 |
| Lemon | 10.2 | 0.4 | Puffed Rice | 6.3 | 5.6 |
| Lettuce head | 11.6 | 0.4 | Puffed Wheat | 7.6 | 7.0 |
| Lettuce leaf (2) | 11.3 | 0.6 | Pumpkin | 4.0 | 0.3 |
| Milk | 1.2 | 0.15 | Quince | 7.8 | 1.4 |
| Molasses | 26.2 | 19.3 | Radishes | 28.7 | 1.6 |
| Mushrooms | 61.7 | 17.9 | Raisins seeded | 3.8 | 2.7 |
| Muskmelon honey dew | 6.5 | 0.7 | Raisins seedless | 3.0 | 2.0 |
| Oatmeal | 5.4 | 5.0 | Raspberries red | 8.3 | 1.3 |
| Olives | 14.7 | 3.4 | Rhubarb | 9.5 | 0.5 |
| Onions | 13.4 | 0.8 | Rice polished | 2.1 | 1.9 |
| Oranges | 6.4 | 0.8 | Rice unpolished | 4.0 | 3.6 |
| Oyster plant | 11.1 | 2.7 | Rutabagas | 8.0 | 1.5 |
| Parsley | 17.3 | 2.1 | Shredded Wheat | 6.7 | 6.2 |
| Parsnips | 7.0 | 1.2 | Spinach | 6.9 | 1.2 |
| Peaches dried | 6.3 | 2.7 | Squash Hubbard | 1.2 | 0.1 |
| Peanuts | 9.7 | 9.6 | Strawberries | 1.9 | 0.2 |
| Pears | 6.3 | 1.0 | Tangerines | 6.2 | 0.9 |
| Peas green | 9.8 | 2.1 | Tomatoes (2) | 9.9 | 0.6 |
| *Peas split* | 15.5 | 11.0 | *Turnips* | 11.0 | 0.9 |
| Pecans | 13.9 | 13.6 | Veal chops | 9.1 | 2.5 |
| *Peppers green* | 16.1 | 1.0 | Walnuts English | 10.3 | 10.0 |
| Pineapple | 8.3 | 0.7 | Watercress | 5.3 | 0.4 |
| *Pistachio nuts* | 12.2 | 11.7 | Watermelon | 9.1 | 0.7 |
| Plums blue | 9.7 | 1.5 | Wheat bran | 12.1 | 11.7 |
| Pork *chops* | 6.8 | 3.1 | Wheat germ | 14.2 | 12.7 |

* When more than one sample was analyzed the number of samples *is indicated* by the figure in parentheses

especially those fed on milk alone or on the cereal gruels used in some areas of the world where milk is scarce A dietary lack of iron is less frequently encountered in the young adolescent *Conditioned* deficiencies of iron are due to the loss of the element in blood and may result from excessive menstrual bleeding chronically bleeding hemorrhoids peptic ulcers hookworm disease or repeated attacks of epistaxis The characteristics of iron deficiency and its treatment are considered in Chapter 24

## COPPER[22]

Copper is an essential nutrient for several species of experimental animals. A deficiency of the element in these species is manifest by a hypochromic, usually microcytic, anemia, depigmentation, and general debility. Decrease in the activities of certain oxidative enzymes (cytochrome, cytochrome oxidase, and catalase) has been observed in the tissues of deficient rats. Herbivora are especially susceptible to copper deficiency, and copper lack has been observed in farm animals under practical feeding conditions. In some instances, occurrence of this deficiency has been associated with a high intake of molybdenum. The anemia of copper deficiency is a reflection of the inability to mobilize iron for hemoglobin production.

Balance studies on man reveal that a daily intake of 2 mg. of copper will maintain adults in balance. The human diet ordinarily contains 2 to 4 mg. of copper per day. It is difficult to prepare a diet containing much less than this quantity of the element. Cartwright[23] has concluded that "an American diet of even mediocre quality easily supplies the daily requirement."

The copper content of whole blood[24,25] is about equally divided between the cells and the plasma. It usually ranges from 90 to 150 micrograms per 100 milliliters for men and 100 to 160 micrograms for women. During the latter half of pregnancy, a rise in the copper content of the serum is observed. Copper is excreted by man in the bile and possibly by the intestinal wall.

In ruminants an antagonism between molybdenum and copper has been observed.[26] High intakes of molybdenum apparently increase the copper requirement of the animal.

Milk is extremely low in copper. Indeed, copper deficiency may be produced in rats by the administration of a diet of milk plus iron. These considerations suggest that copper might be a logical adjunct to iron for the treatment of hypochromic microcytic anemia in infants. Acceptable evidence for a hemopoietic effective copper in such infants however, is scarce. Most infants with hypochromic microcytic anemia respond satisfactorily to the administration of iron preparations which are in common use.

## MOLYBDENUM

Studies in experimental animals do not permit one to classify molybdenum as an essential trace element.[33,34] The ingestion of small amounts of molybdenum in foodstuffs containing 2 to 25 parts per million has been associated in herbivora with an increased requirement for copper and a change in the metabolism of bone.[26] Studies of this copper-molybdenum relationship do not seem to have been made in man. Molybdenum, however, has been widely studied as a problem in industrial toxicology, and the knowledge on it has been summarized by Fairhall and his co-workers.[27]

Several reports deal with a possible therapeutic effect of molybdenum and iron in the treatment of anemia of pregnancy.[28,29,30] Unfortunately, these investigations have not been designed in such a manner as

to allow one to make valid comparisons between the results of treatment with the molybdenum iron preparation and with iron alone in properly classified patients under identical simultaneous conditions of management Furthermore the hematologic characteristics of the anemia have not been defined Until critical studies are available, it is not possible to decide whether molybdenum does enhance the hematologic response of the pregnant woman to the administration of iron There is however, no sound reason to consider molybdenum an essential nutrient for man or to assume that a deficiency of molybdenum arises during pregnancy

## COBALT

Cobalt is an inorganic substance in which there has been a long standing nutritional interest [34] Ruminants pastured in areas deficient in cobalt exhibit a syndrome characterized by anemia and wasting [31,??] There are no reports however of the production of cobalt deficiency in non ruminating animals Cobalt is contained in vitamin $B_{12}$ and Smith and his co workers[35] have demonstrated that this vitamin is effective in alleviating the symptoms of cobalt deficiency in sheep These findings may be interpreted as indicating that cobalt deficiency occurring in ruminants is really a manifestation of a lack of vitamin $B_{12}$ This deficiency of vitamin $B_{12}$ results presumably from the inability of the flora of the rumen to synthesize vitamin $B_{12}$ in the absence of cobalt

The administration of excessive quantities of cobalt to experimental animals produces a true polycythemia [36] This is not due[37] to excessive production of vitamin $B_{12}$ Weissbecker and Maurer[38] reported the production of a similar polycythemia in healthy human subjects following the administration of cobalt salts These salts were given intravenously in quantities of 5 to 10 mg per day These workers also reported that the administration of cobalt exerted a favorable effect on some cases of anemia of infection Similar findings in normal and anemic subjects have been reported by others [39,40] In all instances however the quantities of cobalt given have been large and in the range of pharmacologic dosage rather than at the level of replacement therapy All workers who have administered cobalt in doses which prove hemopoietic have observed and commented upon the occurrence of toxic symptoms such as anorexia and other alimentary tract symptoms malaise and in some instances precordial pain It appears therefore that the effect of cobalt in the treatment of anemias of infection should be attributed to a pharmacologic or toxicologic property of this element in large doses rather than to replacement therapy of a missing trace element

The metabolism of cobalt in man has been but little studied Weissbecker and Maurer[38] state that 60 to 80 per cent of the daily intravenously administered dose was excreted in the urine within twenty four hours and the remainder was excreted in the feces These workers further report a serum content of 0 5 to 1 0 microgram per 100 cc in healthy subjects The length of retention of this metal after the ingestion of therapeutic doses has not been defined for man and there appear to be no data on the cobalt content of normal human tissues

### ZINC

Zinc has been demonstrated to be an essential trace element for experimental animals [39, 34] This mineral is present in crystalline insulin A number of zinc dependent biologic agents are of importance in human metabolism Zinc is related to carbonic anhydrase activity of the blood and Vallee and his associates[41] have noted that the zinc and carbonic anhydrase levels parallel each other in subjects with anemia and polycythemia except in instances of pernicious anemia These observations however *do not imply that zinc deficiency of dietary origin is found in* the human being Indeed Hegsted and his co workers[42] noted that the wide distribution of zinc in nature makes it improbable to think that zinc deficiency is a practical problem in animal or human nutrition

### IODINE

The effectiveness of iodine in the treatment of goiter was early reported by Chatin [43] but this therapy fell into disrepute because of the overenthusiastic use of large doses of iodine which led to signs of iodine intoxication However the discovery of iodine in the thyroid gland[44] by Baumann reawakened interest in the relationship between iodine and goiter Marine and Kimbell[45] in 1920 decisively demonstrated that simple goiter in man can be prevented by the administration of small quantities of iodine Iodine is an essential nutrient for man and animals [46] and its major recognized role in the human organism is the formation of thyroid hormone

The thyroid contains approximately 10 mg of iodine [47] Minute quantities of the element are found in the blood In the serum it is present in at least two forms (1) the protein bound iodine presumably represents the iodine of the circulating thyroid hormone and usually falls within the range of 3 5 to 7 0 micrograms per 100 cc This iodine fraction rises during pregnancy In hyperthyroidism it is usually above a level of 8 micrograms per 100 cc and may be elevated considerably higher In hypothyroidism lower than normal values are found (2) The other fraction of iodine in the serum is the so called inorganic fraction

**Requirement** The human requirement for iodine has been estimated by Curtis and Fertman[48] to be of the order of 1 to 2 micrograms per kilogram of body weight per day The recommended dietary allowance of the Food and Nutrition Board[49] states The requirement for iodine is small probably about 0 002 to 0 004 milligrams daily for each kilogram of body weight or a total of 0 15 to 0 30 milligrams daily for the adult This need is met by the regular use of iodized salt its use is especially important in adolescence and pregnancy The periods of adolescence and pregnancy are intervals of physiologic stress during which the woman is especially susceptible to development of goiter

**Source** The iodine content of foodstuffs depends to a considerable extent upon the iodine content of the soil in which the foods are grown Vegetables grown in the high iodine areas and seafoods are among the most dependable sources of this element Iodized salt such as used in

the United States, contains one part of potassium iodide or a suitable equivalent for each 10,000 parts of salt. The iodide is stabilized in the salt in order to prevent loss. The universal consumption of iodine at the level provided by this salt would insure that a high percentage of our population would receive sufficient iodine. No case of harmful effect of this level of iodine ingestion has been reported. The universal use of iodized salt should be encouraged.[50]

Reports of partial failure of iodized salt to prevent endemic goiter may be explained in part by the low level of iodinization of salt in some regions of the world. In other instances, failure is due to the level of ingestion of the salt by small groups of persons within the population. Thus Osmond and Clements,[51] in studying the salt consumption pattern of children, showed that the salt consumption of some children in the younger age groups was so small that iodinization at any level would not serve to provide sufficient iodine to protect the child against the development of goiter.

Cabbage contains a goitrogenic substance. Ashwood, Greer, and Ettlinger[52] have isolated the goitrogen L-5-vinyl-2-thiooxazolidone from the rutabaga and other members of genus *brassica*. This goitrogen is stated to be equal in potency to thiouracil in man. The exact role, if any, of this substance in the development of goiter in the human being under ordinary conditions of diet has not been defined. The isolation of the compound, however, serves to remind one of the possible importance of noniodine dietary factors in the development of goiter.

The reader interested in an extensive treatment of iodine metabolism and the thyroid will find numerous useful recent reviews.[47,48,53,54]

## FLUORINE

Whether fluorine should be termed an essential trace element for man or animals cannot be decided at this time. Efforts to produce fluorine deficiency in animals have been unsuccessful.[55,56] A considerable body of evidence has accumulated, however, to demonstrate that fluorine plays some role in dental health in the human being.[57,58,59] Much of this evidence is of an epidemiologic nature.

The term "mottled enamel" has been applied to a yellow-brown staining of the teeth, accompanied by aplasia of the enamel and pitting. The geographic distribution of this condition early suggested an association between it and water supplies of high fluoride content.[57] Further support was given to this thesis by the production of an analogous dental condition in experimental animals fed diets containing high levels of fluoride. Finally, it was demonstrated that mottled enamel could be prevented by changing the water supply of an area from a source high in fluorides to one containing minimal quantities of fluorine. *Mottled enamel does not occur except when excessive quantities of fluoride are ingested during the period of enamel formation.* Investigations designed to define the minimal level of fluoride ingestion which will result in mottling of the enamel are in general agreement that barely detectable mottling will not occur in an appreciable percentage of the population

unless the fluoride content of the drinking water exceeds 1 to 2 parts per million (limit often stated to be 1 8 p p m)

Unlike iodine, fluorine is supplied primarily by drinking water Foods seem to vary but little in their fluoride content, whether the food be grown on a soil rich in fluoride or poor in fluoride

The epidemiologic studies of the relationship between mottled enamel and fluoride in water supplies led to the unexpected finding that a decreased incidence of dental caries occurred in populations consuming water which contained 1 part per million of fluoride [58] Thus it became apparent that a concentration of 1 part per million of fluoride in the water supply of an area might be expected to reduce the incidence of dental caries and, at the same time, would not be expected to produce mottled enamel These conclusions are consistent with the findings that the topical application of fluorides to the teeth has been observed to reduce dental caries by approximately 40 per cent Accordingly, feasible, cheap methods for the process of fluoridation of city water supplies have been developed, with the hope that this procedure might reduce considerably the dental caries rate

A number of test situations have been devised to determine whether fluoridation of waters in fluoride free areas to the optimal level of 1 part per million would indeed decrease the dental caries rate among children One such classical study is that of the cities of Newburgh and Kingston in New York State [60] Sodium fluoride has been added to the water supply in Newburgh since 1945, while the control city of Kingston has maintained a fluoride free water supply These studies are not complete, but preliminary indications are that a consistent decrease in the DMF (decayed, missing filled) rate for permanent teeth has occurred in Newburgh, the city with fluoridation The final answer in these studies cannot be given until a considerably longer period has elapsed [60] A number of professional organizations, including the American Public Health Association, the American Dental Association and the State and Territorial Health Offices, have passed resolutions supporting fluoridation of water supplies as a public health measure When such fluoridation is applied, the process must be rigidly controlled in order to maintain a concentration of 1 part per million Sodium fluoride is the fluoridating agent of choice at the present time [61]

In severe cases of fluoride intoxication occurring from industrial exposures, there occurs calcification of ligaments, and muscle attachments gastrointestinal symptoms and anemia [62] This condition has also been reported from India as occurring in populations using drinking water with a fluoride content of 1 to 6 parts per million [63] The actual quantities of fluoride ingested were estimated to vary between approximately 5 and 24 mg per person per day The clinical evidences of injury appeared only in persons who had resided continuously in the area from childhood and hence had been exposed to the high fluoride intake for fifteen to twenty five years It does not appear that such bone changes have been reported from regions in the United States where fluoride ingestion is high

It is apparent, therefore, that if the beneficial effects of fluoride in the

prevention of dental caries are to be obtained safely, critical control of the fluoride ingestion must be maintained. Since the fluoridation of water supplies is becoming widespread, it is well to discourage the addition of fluorine to other articles of diet or dietary supplements in order to reduce the possibility of excessive fluoride ingestion.

### CALCIUM AND PHOSPHORUS[64, 65,66]

Some 99 per cent of the body calcium is found in the skeletal structures, bones and teeth. Phosphorus, on the other hand, is present in both bones and teeth and to a considerable extent in soft tissues. These elements in the bones serve not only as structural components, but also as reservoirs for maintaining the serum content of calcium and phosphorus. The calcium stored in trabeculae of the bone may be rapidly mobilized and exchanged.

**Absorption.** The absorption of calcium from the gastrointestinal tract is under the direct influence of vitamin D. Other factors may be important in altering the absorbability of this element. For example, the presence of large quantities of oxalates in foods such as spinach, beet greens and the like, will reduce the availability of the calcium. Similarly, the ingestion of phytin in whole grains reduces the calcium absorption. These effects are believed to be due to the formation of insoluble salts of calcium.

Calcium is present in the blood plasma in two principal forms, ionizable calcium and calcium bound to protein. McLean and Hastings[67] define the relationship between total serum protein and and total serum calcium and ionized calcium. Their data permit one to determine the quantity of ionized calcium available from a knowledge of the total serum calcium and total serum protein. These relationships are important in understanding the frequently observed phenomenon of low serum protein levels, low total calcium, but absence of tetany. In such instances it is the protein-bound calcium which is low and not the ionizable calcium. The ionizable calcium is the fraction which prevents tetany.

A detailed discussion of the multiple factors which alter calcium metabolism is out of place in this treatment, and the reader is referred to the excellent monograph by Albright and Reifenstein[66] and the discussion of Snapper[65] for such considerations.

**Deficiency.** In the adult, calcium deficiency gives rise to osteomalacia. Osteomalacia is usually a deficiency of both calcium and vitamin D. This condition is exceedingly rare in the United States. On the other hand, it is frequently confused with a relatively common disease of older persons, osteoporosis. Osteoporosis is a metabolic disorder in which there is thinning and decalcification of the bone and even pathologic fractures. This bony decalcification is due to an abnormality of the protein matrix in which calcium is deposited, rather than to a defect due to a lack of calcium.

It is frequently stated that calcium deficiency is exceedingly common in the United States. This opinion is based in part upon the discrepancy between the recommended dietary intakes of calcium and the actual con-

sumption level and in part upon the failure to distinguish osteomalacia and osteoporosis We are not aware of methods which permit one to detect potential deficiencies of calcium and in absence of such evidence we do not agree that calcium lack is a widely prevalent condition in the United States

**Requirement** The question of calcium requirement has been the subject of much disagreement [64 68 69 70 71 72] The multiplicity of factors which alter calcium absorption utilization and retention make it impossible to set a single figure as a requirement Stearns[64] recommends an intake of 1 gm of calcium daily for children before puberty and for adolescents an intake of 1 quart of milk daily plus an otherwise adequate diet This should provide 1 3 to 1 6 gm of calcium as the total daily intake The daily recommended allowance of the Food and Nutrition Board[49] sets the calcium allowance as 1 gm daily for adults 2 gm daily during lactation, and 1 5 gm during pregnancy These allowances are most certainly generous, and there are some who feel that they are excessive

Some justification for liberal intakes of calcium are provided by the life time studies on rats made by Professor Sherman [73] In these investigations he found that an abundant calcium intake supported an enhanced reproductive performance by female rats as measured by the length of the reproductive span the number of offspring and the longevity of both offspring and mothers

**Sources** The principal sources of calcium in the diet are milk cheese and other milk products and green leafy vegetables

**Table 23 Calcium in Typical Foods (Per Cent of the Edible Portion) (Sherman)**

| Food | Number of Cases | Coefficient of Variation | Mean Percentage ± Its Probable Error |
|---|---|---|---|
| Almonds | 31 | 26 | 0 254 ± 0 0078 |
| Apples | 95 | 56 | 0 007 ± 0 00027 |
| Asparagus | 23 | 36 | 0 021 ± 0 0011 |
| Beans dry | 29 | 26 | 0 148 ± 0 0049 |
| Beans snap or string | 53 | 31 | 0 065 ± 0 0018 |
| Beef lean | 45 | 56 | 0 013 ± 0 0007 |
| Beets | 31 | 35 | 0 026 ± 0 0011 |
| Broccoli | 21 | 32 | 0 140 ± 0 0066 |
| Cabbage | 118 | 46 | 0 052 ± 0 0013 |
| Carrots | 50 | 26 | 0 042 ± 0 0010 |
| Cauliflower | 22 | 22 | 0 024 ± 0 00075 |
| Celery (stems) | 12 | 23 | 0 061 ± 0 0027 |
| Cherries | 17 | 26 | 0 017 ± 0 00074 |
| Corn sweet fresh | 17 | 29 | 0 009 ± 0 0004 |
| Dates | 15 | 22 | 0 072 ± 0 0027 |
| Eggs | 36 | 16 | 0 058 ± 0 0010 |
| Milk | 274 | 7 | 0 118 ± 0 00037 |
| Parsnips | 13 | 31 | 0 051 ± 0 0019 |
| Turnip greens | 47 | 23 | 0 274 ± 0 0062 |
| Wheat entire | 94 | 32 | 0 057 ± 0 0013 |

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Although *phosphorus* is an essential element deficiencies of it in man do not appear to be of practical importance A diet adequate in other respects supplies ample phosphorus

**Table 24 Phosphorus in Typical Foods (Per Cent of the Edible Portion)** (Sherman)

| Food | Number of Cases | Coefficient of Variation | Mean Percentage ± Its Probable Error |
|---|---|---|---|
| Almonds | 27 | 23 | 0 475 ± 0 0141 |
| Apples | 82 | 21 | 0 011 ± 0 00017 |
| Asparagus | 16 | 35 | 0 052 ± 0 0030 |
| Beans dry | 32 | 12 | 0 463 ± 0 0066 |
| Beans snap or string | 37 | 26 | 0 044 ± 0 0013 |
| Beef lean | 40 | 11 | 0 204 ± 0 0025 |
| Beets | 35 | 32 | 0 039 ± 0 0014 |
| Broccoli | 14 | 18 | 0 072 ± 0 0023 |
| Cabbage | 103 | 37 | 0 030 ± 0 0006 |
| Carrots | 47 | 32 | 0 040 ± 0 00125 |
| Cauliflower | 23 | 23 | 0 066 ± 0 0021 |
| Celery | 21 | 24 | 0 046 ± 0 0016 |
| Cherries | 10 | 15 | 0 022 ± 0 0007 |
| Corn sweet fresh | 18 | 9 | 0 120 ± 0 0018 |
| Dates | 16 | 21 | 0 060 ± 0 0021 |
| Eggs | 104 | 10 | 0 224 ± 0 0014 |
| Kale | 22 | 25 | 0 067 ± 0 0024 |
| Milk | 214 | 7 | 0 093 ± 0 0003 |
| Parsnips | 11 | 12 | 0 080 ± 0 0020 |
| Potatoes | 135 | 26 | 0 056 ± 0 0008 |
| Turnip greens | 46 | 16 | 0 058 ± 0 0094 |
| Turnips* | 155 | 36 | 0 032 ± 0 0006 |
| Wheat entire | 70 | 14 | 0 374 ± 0 0043 |

* Includes 137 cases from the Rhode Island Agricultural Experiment Station representing unusually wide variations of soil fertilization and cultural conditions

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## SODIUM AND POTASSIUM

Sodium and potassium are essential nutrients Dietary deficiencies of these two nutrients however are exceedingly rare among civilized man Deficiencies of sodium and chloride have been recognized for several decades as a result of excessive loss of these electrolytes in the gastrointestinal tract through protracted diarrhea or vomiting in excessive sweating adrenal cortical insufficiency and in a few other disease conditions When greatly excessive sweating occurs signs of sodium chloride deficiency have been observed[74] These consist in muscular cramps with low chloride concentration in the plasma and in dehydration and vascular collapse with greatly decreased chloride content of the plasma Under such situations ingestion of sodium chloride tablets serves to prevent this syndrome The common practice however of widespread ingestion of sodium chloride tablets during the summer by persons not subject to truly excessive perspiration is unsound Indeed with the widespread interest in the use of low sodium dietaries in the treatment of cardio

vascular disease the question has arisen in the minds of many whether excessive sodium chloride ingestion may be harmful to at least some persons While this question cannot yet be settled it would seem wise to adopt the philosophy of moderation in all things and to consume a reasonable but not excessive quantity of sodium chloride without a definite indication

An exact *requirement* of sodium chloride cannot be set The recommended daily dietary allowances[19] state that 5 gm daily is a liberal allowance and that 1 additional gm of salt should be consumed per liter of water in excess of 4 liters daily to allow for added sodium chloride loss in excessive sweating It is apparent that the liberal use of isotonic sodium chloride solution intravenously may provide large quantities of sodium chloride of which the body must dispose

In recent years *potassium deficiency* has become recognized as a serious and not infrequent electrolyte disturbance [75] The deficiency may occur[76] in diarrheal disease in inanition during the course of fluid therapy [78-79] during insulin therapy of diabetic coma [77] in spruc and in some cases of nephritis

The mechanism of development of hypopotassemia may be a negative potassium balance due to a prolonged maintenance of body fluids by glucose and sodium chloride infusions by increased losses of potassium in the stools during diarrhea [82] or sudden changes in blood volume and potassium distribution within the cells In the treatment of diabetic acidosis with insulin and glucose potassium may be withdrawn from the serum in association with glycogen formation

Potassium deficiency may be manifest by disorientation increased irritability and other nervous manifestations and marked muscular weakness Low serum potassium levels lead to electrocardiographic changes particularly of the T waves Paralysis of the skeletal muscle occurs Indeed the attacks of periodic familial paralysis [80] a hereditary disease are characterized by a pronounced fall in serum potassium level The episodes which are precipitated by violent exercise or high carbohydrate meals may be relieved by the administration of potassium salts in doses of 2 to 8 gm either orally or intravenously This condition of potassium deficiency appears to result from a passage of unusual quantities of potassium into the cell rather than from an excessive loss or a dietary lack

Not only is deficiency of potassium harmful but excessive quantities are toxic [81] Although there is no strict relationship between serum levels of potassium and clinical signs of intoxication usually at a serum concentration of 10 millimols of potassium per liter heart block develops At a concentration of 7 millimols per liter in this serum evidences of cardiac disturbances may be noted in electrocardiographic findings Thus use of potassium in therapy must be carried out with proper respect for the potential dangers of uncontrolled excesses

## WATER

Water is a vitally important factor in nutrition Measured by the urgency of demand and the promptness with which disaster follows f ure of supply it is of greater importance than the ordinary foo

and is second only to oxygen It is the vehicle which transports to the cells the nutritive elements and carries away the waste products of metabolism it furnishes the medium in which all intracellular chemical changes take place

The fluid structures of the body consist of three parts the blood the intracellular fluid, and the interstitial fluid the sum total of which constitutes 70 per cent of the body mass Of this, 5 per cent of the body weight (3 5 liters in a person of 70 kilograms) is circulating plasma 50 per cent (35 liters), intracellular fluid, and 15 per cent (10 5 liters), interstitial fluid This last, which includes the lymph, is the most labile of the three, for in order to preserve intact the other two it must undergo a constant shift in amount and, to a less extent in electrolyte content The electrolytes are of great importance for, as Talbott[93] remarks these and the body water are inextricably bound in their interchange between organism and environment This applies particularly to sodium, potassium chloride bicarbonate, phosphate and protein, electrolytes which control in a large degree physiologic exchange and regulate water balance The importance of these chemical bodies was demonstrated by a group of investigators at Yale University[84] who were able to produce the symptoms and signs of dehydration solely through loss of extracellular electrolytes and with little change in body water, which symptoms were attributed to a shift of extracellular water into the body cells with consequent extracellular dehydration and intracellular hydration

**Table 25 Water Balance (Soderstrom and Du Bois[8] )**

| | | |
|---|---|---|
| Water Intake | Gm | |
| Drinking water | 300 | |
| Water in coffee milk soup | 580 | |
| Water in solid foods | 720 | |
| Water from oxidation of 100 gm of protein | 41 | |
| Water from oxidation of 110 gm of fat | 118 | |
| Water from oxidation of 211 gm of carbohydrate | 135 | |
| | | 1894 |
| Water Output | Gm | |
| Water in urine | 750 | |
| Water in feces | 300 | |
| Water vaporized through skin and respiratory passages | 700 | |
| | | 1750 |
| Plus balance to body | | 144 |
| Gain in body weight | | *100* |

The importance of water is not limited to its uses as a solvent and medium for chemical change it serves other important physical purposes Its evaporation from the lungs and skin is one of the chief factors in the regulation of body temperature

Absorption of water takes place in the large and small intestines little or none being absorbed from the stomach Water leaves the body through the kidneys the lungs the skin and the bowel Table 25 gives an estimate made by Soderstrom and Du Bois[85] of the intake and output of water

under approximately normal conditions. Attention is called to the fact that the organism receives water from three sources (a) ingested fluids (b) the water contained in solid foods and (c) the water produced in the chemical reactions of metabolism. Under normal conditions a fairly accurate balance of intake and output is maintained.

Solid foods all contain water, some in large amounts and from this source alone the ordinary mixed diet may provide as much as a liter of water a day. Obviously, the oxidation of organic matter, such as constantly takes place in metabolism must result in the production of an appreciable amount of water; in fact, it is probable that intracellular reactions and readjustments take place in water of the cell's own making.

**Table 26 Water Content Above 50 Per Cent** (Rowntree[87])

| Food | Water, Per Cent | Average Serving Gm | Calories | Food | Water Per Cent | Average Serving Gm | Calories |
|---|---|---|---|---|---|---|---|
| Cucumbers | 95.4 | 50 | 8.92 | Cod steaks fresh | 79.7 | 100 | 81.32 |
| Lettuce | 94.7 | 25 | 4.9 | Smelts | 79.2 | 100 | 88.9 |
| Wax beans canned | 94.6 | 100 | 17.74 | Lobster | 79.2 | 100 | 83.98 |
| Celery | 94.5 | 50 | 9.48 | Lima beans canned | 78.5 | 100 | 79.0 |
| Asparagus canned | 94.4 | 100 | 18.56 | Macaroni cooked | 78.4 | 100 | 91.03 |
| Tomatoes fresh | 94.3 | 100 | 23.4 | Brook trout | 77.8 | 100 | 98.25 |
| Tomatoes canned | 94.0 | 100 | 23.18 | Green corn canned | 76.1 | 100 | 100.52 |
| Brussels sprouts | | | | Potatoes boiled | 75.5 | 100 | 88.67 |
| canned | 93.7 | 100 | 21.02 | Halibut | 75.4 | 100 | 124.62 |
| Beef juice | 93.0 | 100 | 25.67 | Bananas | 75.3 | 100 | 101.11 |
| Whey | 93.0 | 100 | 27.39 | Plums | 74.5 | 100 | 82.0 |
| Water melon | 92.0 | 100 | 29.81 | Cream 18 per cent | 74.0 | 100 | 200.75 |
| Radishes | 91.8 | 50 | 15.02 | Mackerel | 73.4 | 100 | 142.7 |
| Onions boiled | 91.2 | 100 | 41.75 | Egg boiled | 73.2 | 50 | 56.3 |
| Buttermilk | 91.0 | 100 | 36.63 | Rice boiled | 72.5 | 100 | 112.45 |
| Strawberries | 90.4 | 100 | 40.0 | Cottage cheese | 72.0 | 50 | 56.3 |
| Spinach cooked | 89.8 | 100 | 22.06 | Veal leg | 71.7 | 100 | 147.24 |
| Beet greens cooked | 89.5 | 100 | 75.80 | Liver | 71.0 | 100 | 132.46 |
| Peaches | 89.4 | 100 | 42.34 | Sweet breads | 70.9 | 100 | 191.41 |
| Pineapple | 89.3 | 100 | 44.2 | Tongue | 70.8 | 100 | 163.5 |
| Koumiss | 89.3 | 100 | 53.15 | Chicken white meat | 70.3 | 100 | 158.57 |
| Beets cooked | 88.6 | 100 | 40.5 | Lamb leg roast | 67.1 | 100 | 198.81 |
| Oysters solids | 88.3 | 100 | 50.2 | Pork tenderloin | 66.5 | 100 | 198.39 |
| Squash canned | 87.6 | 100 | 51.39 | Salmon fresh | 64.6 | 100 | 209.24 |
| Milk | 87.0 | 100 | 71.23 | Salmon canned | 63.5 | 100 | 208.47 |
| Oranges | 86.9 | 100 | 52.7 | Sirloin steak | 61.9 | 100 | 249.54 |
| Egg whites | 86.2 | 32 | 17.6 | Bologna | 60.0 | 100 | 240.35 |
| Peas canned | 85.3 | 100 | 56.8 | Turkey white meat | 58.5 | 100 | 187.43 |
| Apple | 84.6 | 100 | 64.57 | Pork and beef | | | |
| Boiled oatmeal | 84.5 | 100 | 63.28 | sausage | 55.4 | 100 | 303.67 |
| Pears | 84.4 | 100 | 64.9 | Sardines canned | 52.3 | 100 | 277.51 |
| Haddock fresh | 81.0 | 100 | 73.3 | Corned beef | 51.8 | 100 | 276.16 |
| Clams solids | 80.8 | 100 | 75.0 | Ham boiled smoked | 51.3 | 100 | 290.84 |
| rPanes | 79.6 | 100 | 80.18 | Mutton leg roast | 50.9 | 100 | 312.68 |

(This table was prepared by Mary Foley dietitian of the Mayo Clinic.)

Table 26, prepared by Miss Foley at the Mayo Clinic, shows the water content of numerous foods. Magnus-Levy[86] estimates the amount of water produced in the metabolism of food as follows:

| | |
|---|---|
| 100 gm. of fat | give 107.1 gm. of water |
| 100 gm. of starch | give 55.5 gm. of water |
| 100 gm. of protein | give 41.3 gm. of water |
| 100 gm. of alcohol | give 117.4 gm. of water |

Water is lost to the body through vapor from the lungs, sweat, gastrointestinal discharges and urine. That lost through the first three of these channels is the most important and, according to Talbott, amounts to about 2 liters daily. The kidney functions as a buffer organ for the disposal of fluid just as do the intercellular spaces and lymph channels for the storage of fluid. Insensible perspiration is as a rule of more importance in this respect than sweat, but during hard work in a hot environment this relationship is reversed. Under such circumstances as much as 10 to 15 liters of sweat containing 3 or 4 gm. of sodium chloride may be lost in eight hours.[83]

Lack of fluid in the body leads to thirst. This sensation, however, when associated with dehydration, according to Talbott, is probably an index of salt lack as well as fluid lack. If the dehydration is extreme, water without salt will not relieve thirst. Complete deprivation of water will within a short time produce great distress; as a rule it means death within sixty to seventy-two hours. Anhydremia leads to definite renal impairment, as is evidenced by an increase of the nonprotein nitrogen, urea and sugar contents of the blood. It may lead to poor absorption of food from the bowel and to vomiting and diarrhea. There is profound disturbance of heat regulation accompanied by marked elevation of temperature when anhydremia is produced in animals, a dehydration fever.

Water intoxication is the term given by Larson, Winn and Rowntree to a group of symptoms exhibited by dogs when large amounts of water are administered through a stomach tube. These symptoms include frequency of urination and of bowel movement, nausea, vomiting, tremor and restlessness, ataxia, convulsions and coma. More recently Helwig and Schutz[88] reported a fatal case of apparent water intoxication in a woman of fifty years who, after an operation, received by proctolysis 9 liters of tap water in thirty hours. Necropsy showed, among other changes, acute swelling of the brain. This condition was reduplicated in each of six rabbits given equivalent amounts of tap water by rectum. A subsequent report from the same authors[89] indicates that these effects can be alleviated by the administration of hypertonic solutions of sodium chloride. Nonetheless this constitutes a warning against the injudicious forcing of water after operations.

Unconscious and semiconscious patients as a rule do not obtain enough water. Because of this neglect, great distress and even death may follow. Uncontrollable vomiting or severe diarrhea (Asiatic cholera; colitis in children) may lead to grave anhydremia and death. An adequate supply of water is of infinitely more importance than food or medicine; too

much cannot be said of the responsibility of physicians and nurses in making sure that the sick person has a sufficient intake of fluids

The proper daily intake of fluids varies within wide limits from 1000 to 3000 cc of water in the form of drink or as liquid food is appropriate for the healthy man In certain diseases it is desirable to increase and *in others to decrease this amount*

For further information concerning water balance and anhydremia the reader is referred to the complete discussions of these related subjects by Adolph [74] and Marriott [74] and Talbott[83] and to the exhaustive review by Peters [90] The insensible loss of water has been fully discussed by Newburgh and Johnston,[91] and the management of disturbances in water metabolism by Atchley [92]

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Table 26 prepared by Miss Foley at the Mayo Clinic, shows the water content of numerous foods Magnus Levy[80] estimates the amount of water produced in the metabolism of food as follows

| | |
|---|---|
| 100 gm of fat | give 107 1 gm of water |
| 100 gm of starch | give 55 5 gm of water |
| 100 gm of protein | give 41 3 gm of water |
| 100 gm of alcohol | give 117 1 gm of water |

Water is lost to the body through vapor from the lungs, sweat gastro intestinal discharges and urine That lost through the first three of these channels is the most important and, according to Talbott, amounts to about 2 liters daily The kidney functions as a buffer organ for the disposal of fluid just as do the intercellular spaces and lymph channels for the storage of fluid Insensible perspiration is as a rule of more importance in this respect than sweat, but during hard work in a hot environment this relationship is reversed Under such circumstances as much as 10 to 15 liters of sweat containing 3 or 4 gm of sodium chloride may be lost in eight hours [83]

Lack of fluid in the body leads to thirst This sensation, however when associated with dehydration, according to Talbott, is probably an index of salt lack as well as fluid lack If the dehydration is extreme water without salt will not relieve thirst Complete deprivation of water will within a short time produce great distress as a rule it means death within sixty to seventy two hours Anhydremia leads to definite renal impairment, as is evidenced by an increase of the nonprotein nitrogen urea and sugar contents of the blood It may lead to poor absorption of food from the bowel and to vomiting and diarrhea There is profound disturbance of heat regulation accompanied by marked elevation of temperature when anhydremia is produced in animals, a dehydration fever

Water intoxication is the term given by Larson, Winn and Rowntree to a group of symptoms exhibited by dogs when large amounts of water are administered through a stomach tube These symptoms include frequency of urination and of bowel movement nausea, vomiting tremor and restlessness ataxia, convulsions and coma More recently Helwig and Schutz[88] reported a fatal case of apparent water intoxication in a woman of fifty years who, after an operation, received by proctolysis 9 liters of tap water in thirty hours Necropsy showed among other changes acute swelling of the brain This condition was reduplicated in each of six rabbits given equivalent amounts of tap water by rectum A subsequent report from the same authors[89] indicates that these effects can be alleviated by the administration of hypertonic solutions of sodium chloride Nonetheless this constitutes a warning against the injudicious forcing of water after operations

Unconscious and semiconscious patients as a rule do not obtain enough water Because of this neglect great distress and even death may follow Uncontrollable vomiting or severe diarrhea (Asiatic cholera colitis in children) may lead to grave anhydremia and death An adequate supply of water is of infinitely more importance than food or medicine too

much cannot be said of the responsibility of physicians and nurses in making sure that the sick person has a sufficient intake of fluids

The proper daily intake of fluids varies within wide limits from 1000 to 3000 cc of water in the form of drink or as liquid food is appropriate for the healthy man In certain diseases it is desirable to increase and in others to decrease this amount

For further information concerning water balance and anhydremia the reader is referred to the complete discussions of these related subjects by Adolph,[74] and Marriott [74] and Talbott[83] and to the exhaustive review by Peters [90] The insensible loss of water has been fully discussed by Newburgh and Johnston,[91] and the management of disturbances in water metabolism by Atchley [92]

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# 7

## *Nutritional Factors of Lesser Importance*

### SATIETY VALUES

Man eats in order to feel satisfied He thinks little about the nutritive value of his food, in the selection of which the main question, unconsciously asked, is 'Is this food satisfying?

Several factors no doubt combine to give this sense of satiety, chief among them is the physiologic activity of the digestive tract Lack of food, with the accompanying rhythmic gastric contractions gives rise to the sensation which is interpreted as hunger—even to hunger pains while a full stomach, physiologically active, with its muscular and secretory functions fully unfolded, produces the opposite feeling a sense of satisfaction The food which gives this sensation in highest degree and longest is that which remains longest in the stomach and small intestine and demands of these organs greatest functional activity Foods as a rule show the same behavior in this respect in both the stomach and the intestine for those foods which remain longest in the stomach and call forth the greatest secretion of hydrochloric acid also remain longest in the intestine For such foods a greater length of time is required in the intestine for the neutralization of the acid which comes from the stomach and therefore a longer time for the completion of digestion The satiety value of an article of diet can therefore be measured in two ways (*a*) by the length of time the food remains in the stomach and (*b*) *by the amount of gastric juice stimulated by it*

This subject has been studied by Kestner,[1] who classified foods according to their satiety value It is interesting to note from the tables given by him that meat calls forth an amount of gastric secretion which is directly proportional to the amount eaten, whereas certain other foods such as bread potatoes and butter, when eaten in increased amounts do not excite a proportionate increase in gastric juice This is explained by the fact that in the former instance the exciting agents are chemical—meat extractives—and that the stimulus exerted by them is directly proportional to their amount, while in the latter instance the stimulus to secretion is dependent on psychic influences and therefore may be no greater after the ingestion of 100 gm of bread than after the ingestion of 50 gm This is illustrated in Table 27 in which it may be seen that little increase occurs in gastric secretion when the amount of potatoes

in the diet is doubled whereas a material increase occurs when the amount of meat is doubled

**Table 27 Increase in Gastric Secretion on Ingestion of Different Quantities of Potatoes and Meat**

Thus the great importance of meat as a food lies not only in its fuel value and in its ability to replace worn out structures but also in its quality of calling forth great physiologic activity of the stomach which in turn gives it great satiety value It is well known that a meal which contains meat sticks to the ribs and lasts longest

Next to meat in satiety value stands milk the richer the milk the greater in this respect is its value The satisfying quality of eggs depends somewhat on the cooking Raw eggs leave the stomach much more rapidly than soft boiled eggs while those that are hard boiled remain longest and call forth the greatest amount of secretion Cooked eggs are to be preferred to raw eggs not only because they are more easily digested but also because their satiety value is greater

Fish is of much lower satiety value than meat or eggs probably because fish yields less of the stimulating extractives than does meat The same applies to oysters but not to eel and other fish rich in fat

The satiety value of bread is relatively low it is still lower when toasted The addition of butter however because of its high fat content greatly enhances the staying qualities of the bread which perhaps explains why buttered bread is preferred Potatoes belong in the same category as bread although in isodynamic quantities the former are of definitely higher satiety value This low rating of bread and potatoes, however does not hold good under all circumstances for when these foods are eaten with meat they have the power of increasing still further the satiety value of the meal

Green vegetables such as spinach lettuce and asparagus also have relatively low satisfying qualities Unlike bread and potatoes they add little to the satiety value of meat Likewise coarse articles which are entirely indigestible such as bran and paraffin remain in the stomach only a short time and have no satiety value [2]

Fats such as butter and olive oil by retarding the emptying of the stomach increase the satiety value of the meal This quality of fat depends somewhat on its melting point and viscosity The great satiety value of fat perhaps explains why a salad is more enjoyable when taken with an oil dressing

The influence of sugar on the satiety value of the diet is important This has been demonstrated by experiment as well as by experience For instance a test meal containing bouillon meat butter and potatoes was given twice first without sugar and then with sugar Without sugar the gastric secretion was 1200 cc and the evacuation time was three and one half hours with sugar the secretion was 1288 cc and the evacuation time eight hours Thus a meal to which something sweet has been added stays longer in the stomach and therefore has greater satiety value

The satiety values of the various foods show that a meal which contains meat gives the greatest degree of satisfaction, and if bread and potatoes are added particularly the latter, the sense of comfort and well being is increased If the bread is buttered, so much the better and if at the end of the meal something sweet is eaten, the satiety value becomes still greater Thus is seen the rationale of that type of meal which the race has instinctively chosen first, a soup (meat extractives) second meat with potatoes, to which may be added certain other starchy vegetables then a salad with oil dressing and finally a dessert This meal remains longest in the upper portion of the gastrointestinal tract calls forth the greatest amount of secretory activity, and gives the greatest degree of satisfaction

## ROUGHAGE

The food of man, like that of the lower animals, contains 'roughage —of value not only because of the vitamin carrying properties of the rough native foods such as vegetables but for other reasons as well

The stimulus which favors best the functional activity of the large intestine and which promotes regular evacuation comes from a large semisolid bowel content Such a bowel content not only gives the mucous membrane its normal stimulus but also is the type of mass which the intestine can move forward with greatest ease A more concentrated dry, solid fecal mass has a different effect it is irritating rather than stimulating it is difficult of propulsion and it tends to accumulate in the haustra where it may remain for a long time Much of the constipation complained of is due to a diet which leaves this type of residue

To assure a large semisolid bowel content, food of the right kind is essential With advancing civilization, man has gradually changed his diet to one which tends to be more refined and more concentrated the hull of the grain the peel of fruits and the abundance of vegetable fiber formerly eaten are now missing This is wrong The food that leaves the most satisfactory type of bowel residue contains a great deal of cellulose or related materials Such substances resist the action of the digestive ferments and remain behind as indigestible residues to be acted upon by the intestinal bacteria Williams and Olmsted [3] in their studies on healthy medical students, observed that of the three indigestible portions of carbohydrate foods lignin, cellulose and hemicellulose, the first two have little or no effect and the last one is the most efficacious in increasing the bulk of the stool These authors state

> Contrary to the accepted belief the effectiveness of indigestible residues is not due primarily to the mechanical stimulus of distention but rather to chemical stimuli which arise from the destruction of hemicellulose and cellulose by the intestinal bacterial flora One of these stimulating products is the lower volatile fatty acids There may be others The chemical stimuli are aided by the hygroscopic quality of the residue escaping degradation

This fermenting material, when mixed with the other fecal matter, gives to the mass the proper bulk and a soft consistency This is the ideal fecal mass

The authors just quoted state that alfalfa leaf and cottonseed hull substances high in lignin, have little effect, while bran, carrots corn germ

meal, beet pulp, cabbage and agar, substances high in hemicellulose, are definitely laxative Other vegetables and fruits, notably spinach, turnip greens, cauliflower, lettuce, celery, peas, beans, peaches, apples, pears, melons and berries, are also effective The results are still better if fruits are eaten with the peeling

A broader physiologic importance is ascribed to the unavailable carbohydrates" which constitute the crude fiber of the diet by Hummell and her co-workers,[7] whose studies of children would indicate that these substances, notably lignin, may have a protein sparing action They believe that the kind of fiber, that is, the proportion of lignin to cellulose and hemicellulose, may be of physiologic significance, and they point out that the distribution of these bodies in the food may be altered without changing the total fiber intake or caloric value of the daily diet This they believe, may have an influence on nutritional processes

Table 28 The Unavailable Carbohydrate Content and Distribution in 14 Common Foods (Hummell Shepherd and Macy[7])

| | Residue‖ per 100 Gm Wet Food | | | | Percentage Composition of Total Residue‖ | | | Hemicellulose | |
|---|---|---|---|---|---|---|---|---|---|
| | Total | Lignin | Cellulose | Hemicellulose | Lignin | Cellu | Hemicellulose | Per Cent Stable | Per Cent Labile |
| | gm | gm | gm | gm | | | | | |
| Apple* | 0 82 | 0 22 | 0 42 | 0 18 | 27 | 51 | 22 | 86 | 14 |
| Banana, ripe† | 0 83 | 0 50 | 0 21 | 0 12 | 60 | 25 | 15 | 85 | 15 |
| Bread white | 0 84 | 0 07 | 0 27 | 0 50 | 8 | 32 | 60 | 54 | 46 |
| Bread, whole wheat | 2 86 | 0 47 | 0 67 | 1 72 | 16 | 24 | 60 | 62 | 28 |
| Cabbage§ | 1 01 | 0 11 | 0 53 | 0 37 | 10 | 53 | 37 | 70 | 30 |
| Carrot§ | 1 09 | 0 11 | 0 61 | 0 37 | 10 | 56 | 34 | 50 | 50 |
| Corn flakes | 1 40 | 0 21 | 0 76 | 0 43 | 15 | 54 | 31 | 0 | 100 |
| Graham crackers | 2 16 | 0 86 | 0 53 | 0 77 | 40 | 24 | 36 | 100 | 0 |
| Lettuce‡ | 0 64 | 0 08 | 0 35 | 0 21 | 12 | 55 | 33 | 56 | 44 |
| Peanut butter‡ | 1 34 | 0 21 | 0 60 | 0 53 | 16 | 45 | 39 | 74 | 26 |
| Potato§ | 0 54 | 0 06 | 0 34 | 0 14 | 11 | 62 | 27 | 69 | 31 |
| Shredded wheat | 5 92 | 0 80 | 1 65 | 3 47 | 13 | 28 | 59 | 97 | 3 |
| Tomato juice‡ | 0 15 | 0 01 | 0 11 | 0 03 | 7 | 75 | 18 | 0 | 100 |
| Spinach‡ | 0 56 | 0 13 | 0 29 | 0 14 | 23 | 51 | 26 | 69 | 31 |

* [illegible]
[illegible]
‡ [illegible]
§ [illegible]
total fiber

In order to compensate for the losses which occur in the milling of grains, bran is now being extensively eaten Falcon Lesses[4] stated that this food acts as a laxative in a quantitative fashion and that increasing amounts of bran produce increasing weights of feces He concluded that its action is due to crude fiber and pentosans The later studies of Rose and her associates[5] upon a group of girls and young women, however, indicated that the laxative effect of bran can be attributed to the combined effects of its fiber and its content of B vitamins It is significant,

too, that the latter workers found the response to bran to be just as satisfactory in the second month of its use as in the first, and that in a series of animal experiments they saw no evidences of damage done by this food to the intestinal tract

This influence of bran on intestinal motility was studied roentgenologically by Fantus and his associates,[6] who observed that while bran accelerates evacuation in those persons whose cecal emptying time is slow, it does not accelerate optimum evacuation of the cecum or change to any extent the normal sequence of events in the bowel They believe that crude fiber is the active principle of the bran and that this undergoes some change in the alimentary tract The most significant change in stools after the addition of bran is a softening and an increase in the stool weight Plain, ordinary washed bran, when taken with cream and sugar, makes a palatable dish Bran muffins are popular and wholesome In reporting their experiments with college students Hoppert and Clark[8] write of the desirable effect produced by two such muffins on the consistency of the stools and the ease of movement The following recipe for bran muffins is used by a famous hostlery Puddings made of bran

RECIPE FOR BRAN MUFFINS

| | |
|---|---|
| 8 oz bran | ¼ teaspoonful salt |
| 4 oz graham flour | 2 eggs |
| 3 oz white flour | 2 tablespoonfuls butter |
| 1 teaspoonful baking powder | 1 cup milk |

Makes 2 dozen muffins

are equally effective The most satisfactory thing however, is a breakfast dish of bran stewed fruit and cream

To provide, then, an abundance of cellulose it is sufficient to eat each day a dish of bran at breakfast (provided it is well borne) and at the other meals one liberal helping of any salad, two liberal helpings of any green vegetable and a reasonable quantity of fruit Such a diet provides not only the desirable roughage, but also in large measure the required amount of vitamins

A note of warning here is appropriate It has been suggested that indigestible material of this sort when added to the diet leads to incomplete or subnormal digestion and therefore to poor utilization of the contained protein Evidence of this is seen in the studies of Murlin and his associates [9] who found that whole wheat bread showed digestion rates for protein and carbohydrate 61 per cent and 11 per cent respectively slower than those for white bread Smaller differences were seen by Funnell and her associates,[10] who found that added fiber reduced the coefficient of digestibility of the diet as a whole only about 3 per cent while bran reduced it 11 per cent The loss in the last instance was regarded by these workers as representing in part unabsorbed bran proteins and in part extra metabolic products due to the greater laxative effect of the bran

A more cogent objection to the too liberal use of roughage is the clinical observation that this type of diet is not well borne by everyone For the majority of persons a liberal intake of green vegetables and other rough foods is wholesome, but for some persons such a diet produces

vague abdominal discomfort and even pain When the roughage is no longer taken and the diet is confined to smooth nonirritating foods the discomfort disappears These persons are said to have an irritable colon This handicap is not to be disregarded

For these patients as well as those with peptic ulcer and other forms of gastrointestinal disturbances therefore the inclusion of roughage in the diet is inadvisable In such cases agar is effective as are products made from psyllium seed of which there are several on the market

## DIGESTIBILITY

The word digestibility has been given several meanings (1) the percentages of the several nutrients of a food which are available to the body for use as fuel or building material—the coefficient of digestibility (2) the ease and comfort with which it is assimilated as measured by the demands it makes upon the stomach and intestines (3) the smallness of the residue which it leaves in the intestine and (4) the infrequency with which it calls forth untoward symptoms It is used in the first sense in scientific literature and with the other meanings in medical practice and everyday parlance

The *coefficient of digestibility* of all foods is surprisingly large Atwater[11] showed that of the nutrients contained in a mixed diet the following average amounts are utilized protein 92 per cent fat 95 per cent and carbohydrate 97 per cent

Foodstuffs from animal sources are more completely utilized than those from vegetables Hegsted and his associates[12] found the digestibility value of the protein in an all vegetable diet to be 87 5 per cent Diets containing meat and bread showed slightly higher values and those containing soy flour and wheat germ slightly lower values

Of protein from animals 97 per cent is used of protein from vegetables 84 per cent of fat from animals 95 per cent of fat from vegetables 90 per cent of carbohydrate from animals 98 per cent and of carbohydrate from vegetables 97 per cent

Contrary to the lay opinion fats are not poorly digested as is indicated by the *high coefficient of digestibility of fat* Langworthy[13] *in his* studies on animal fats found that the coefficients of digestibility range from 97 per cent for butter to 88 per cent for mutton fat He observed that the presence of considerable quantities of fat in the diet (about 100 gm ) did not alter the digestibility of the other foodstuffs For instance the digestibility of the carbohydrate quota independent of the kind of fat and of its amount remained practically the same about 97 per cent The average coefficient of available energy from all sources was approximately the same (91 to 93 per cent) no matter what the kind of fat or within the limits of the experiment its amount He concluded that fats do not appreciably influence the digestibility of the other food

The interesting observation was made that beef fat differed from the other fats tested (lard mutton fat and butter) in that it often produced diarrhea when as much as 140 gm were taken whereas the other fats taken in like amounts did not show such a tendency

These studies by Langworthy led to the generally accepted conclusion that fats of low melting point are more completely assimilated than those which are fluid only at a higher temperature. A similar conclusion was reached in the studies of Mattil and Higgins,[14] but these authors, like Holt and his associates,[15] point out that other factors also are of influence. They state that the type of glyceride in which the fat occurs in the food is an equally important factor in determining its digestibility.

The completeness with which a food is utilized depends somewhat on its physical state; hence the advantage of cooking. This is illustrated in the experiments of Rose and MacLeod, who compared the digestibility of raw egg white with that of cooked egg white. They found that in the same diet the coefficients of digestibility were 80 per cent for the one and 86 per cent for the other. The more recent studies of Hosoi indicate that raw egg white runs through the digestive tract so rapidly that it escapes digestion. Rose and MacLeod found that this food is more completely utilized when it is beaten, and Hosoi observed that its addition to milk resulted in a mixture which was better digested than either food alone.

Psychic factors do not seem to influence the ultimate utilization of food, for Hawk and his associates[16] found that protein prepared in an unpalatable manner was as completely utilized as that which had been more attractively served.

For the commoner food materials, Atwater[11] found, in a large series of experiments on man, that the fuel value per pound and the coefficients of digestibility were about as shown in Table 29.

**Table 29. Coefficients of Digestibility and Fuel Value per Pound of Nutrients in Different Groups of Food Materials (Atwater)**

| Kind of Food | Protein | | Fat | | Carbohydrate | |
|---|---|---|---|---|---|---|
| | Digestibility, per Cent | Fuel Value per Pound, Calories | Digestibility, per Cent | Fuel Value per Pound, Calories | Digestibility, per Cent | Fuel Value per Pound, Calories |
| Meats and fish | 97 | 1940 | 95 | 4040 | 98 | 1730 |
| Eggs | 97 | 1980 | 95 | 4090 | 98 | 1730 |
| Dairy products | 97 | 1940 | 95 | 3990 | 98 | 1730 |
| Animal food (of mixed diet) | 97 | 1940 | 95 | 4050 | 98 | 1730 |
| Cereals | 85 | 1750 | 90 | 3800 | 98 | 1860 |
| Legumes (dried) | 78 | 1570 | 90 | 3800 | 97 | 1840 |
| Sugars | . | . | .. | | 98 | 1750 |
| Starches | | | | | 98 | 1860 |
| Vegetables | 83 | 1410 | 90 | 3800 | 95 | 1800 |
| Fruits | 85 | 1520 | 90 | 3800 | 90 | 1630 |
| Vegetable foods (of mixed diet) | 84 | 1840 | 90 | 3800 | 97 | 1820 |
| Total food (of mixed diet) | 92 | 1820 | 95 | 4050 | 97 | 1820 |

The *ease* and *comfort* with which food is disposed of by the stomach and intestine comprise what is usually taken to be its digestibility. This depends on many factors, chiefly the secretory and motor response which

the food calls forth and the subjective sensation which it produces The latter is determined in large measure by the former These several influences in turn are dependent on the physical state of the food its chemical composition and its appeal to the appetite In addition to these factors digestibility is often governed by idiosyncrasy This follows no law it is often psychic sometimes allergic and not infrequently of unknown nature

Hawk and his associates studied the secretory and motor response called forth by various foods in a number of healthy men They assumed that the foods which remain in the stomach a shorter time and call forth less secretory response are the more digestible Their studies of milk[17] revealed surprising facts They found that when milk is drunk rapidly it makes smaller curds and leaves the stomach more quickly than when it is slowly sipped Boiled milk (five minutes) produces a much smaller softer more flaky curd which leaves the stomach sooner and obviously is more digestible than raw milk Whole milk gives smaller curds which leave the stomach sooner than those of skim milk the latter are particularly unyielding and tough The curds of boiled skim milk are not as tough as those of raw milk but are not as soft as those of whole milk Very rich milk retards the emptying of the stomach but not to as great an extent as skim milk Pasteurization improves the state of the curd but not as much as does boiling

Roast beef according to these investigators[18] is handled by the stomach with equal ease whether it is rare medium or well done Hamburger steak and stewed beef remain in the stomach about the same length of time as roast beef but roast beef calls forth less rapid development of acidity Corned beef and dried beef have about the same influence Calf s liver remains in the stomach a slightly longer time while frankfurters and sweetbreads leave more quickly One hundred grams of beef remained in the stomach for two and a half to three and a half hours Lamb[19] was found to remain in the stomach on an average a few minutes longer than beef but not as long as pork Sheep brains are evacuated more rapidly Pork[20] was found to leave the stomach a little more slowly than beef but it is not retarded to the extent ordinarily believed Sausage leaves the stomach more quickly than pork chops Fried ham requires considerably more time Bacon also takes a long time

Eggs[21] were found to give rise to less stimulation of gastric juice and to leave the stomach sooner than meats the acidity produced by an egg is only 80 while that of beef is 120 Raw egg white leaves the stomach more rapidly and produces less response than any other egg preparation The yolk and the whole egg taken raw have almost the same influence they stay in the stomach longer and cause more acidity than the simple white Hardboiled eggs remain longer than those that are softboiled but the acid response is the same Shirred and poached eggs have the same effect as softboiled eggs Raw whole eggs remain longer in the stomach than boiled eggs but produce lower acidity Fried eggs strange to say were handled by the stomach in these experiments as easily as boiled eggs Scrambled eggs or eggs made into an omelet leave the stomach more slowly

Among the vegetables,[22] it was found that white potatoes, whether boiled, creamed, mashed or baked, leave the stomach in a moderate length of time Potato salad and potato chips are handled with the same ease Baked potato eaten with butter leaves the stomach sooner than when the butter is omitted Sweet potatoes, no matter how cooked remain in the stomach longer than the white variety Boiled red beets raw carrots and radishes are quickly evacuated Boiled carrots remain in the stomach a little longer Baked beans, perhaps because of their high protein content, *remain in the stomach longer than any other vegetable* and are accompanied by higher acidity Peas and string beans leave a little more quickly and cabbage still more rapidly Lettuce is quickly evacuated, the addition of vinegar or oil causes the stomach to retain it longer Onions are slower in leaving the stomach than other vegetables with a low protein content Raw tomatoes and stewed corn leave the stomach rapidly

These investigators summarize their observations on vegetables as follows

In general vegetables low in protein as carrots celery, tomatoes cabbage lettuce and cucumbers leave the stomach rapidly develop moderately high free acid but little combined acid and leave the stomach without great change Boiled vegetables show much more rapid and complete disintegration Vegetables high in starch such as potatoes show considerable starch disintegration before leaving the stomach In certain cases hardly any starch reaction could be obtained towards the end of digestion

Studies[23] of the digestibility of pies, pastries and puddings show that pie crust properly made is not necessarily difficult for the stomach to handle Pie crust alone remains in the stomach longer than whole pie The addition of ice cream to pie makes little difference, but cheese materially lengthens the time that the pie remains in the stomach It is interesting that in these experiments angel food cake remained in the stomach longer and called forth higher acidity than did devil s food cake fried cakes, such as doughnuts, stayed in the stomach longer, but crisp light cakes, such as cookies, left the stomach quickly It was found that puddings leave the stomach rapidly and that *the addition of rice or tapioca hastens the evacuation* Puddings which have a high protein content, such as Indian pudding and cup custard, develop a higher acidity

In these studies, tea and coffee,[24] whether hot or cold, appeared to have no effect on the emptying of the stomach, the addition of sugar alone, but not of sugar and cream, delayed this process somewhat Large quantities of cocoa (1 liter) delayed evacuation These investigators noted certain unmistakable nervous symptoms when coffee or tea was given in large quantities (I liter)

Large quantities of cane sugar[25] in concentrated form delay the evacuation of the stomach, but smaller quantities in solution have no such effect Candies taken in large amount have a similar effect the addition of flavoring extracts and other substances, such as milk has a modifying effect Hard candies eaten slowly have little influence, but soft candies have the delaying effect of concentrated sugar solutions *The* addition of honey to bread does not influence the evacuation, but the secretion of acid is thereby somewhat delayed

These investigators[10] also studied psychic influences in their relation to

digestion They found that susceptible persons exhibit marked differences in digestive response It was evident that the sight of a well set table containing attractive food gives rise to marked secretory activity, while the same food poorly prepared and poorly served calls forth less gastric response It was found, strange to say, that sight is more influential in this respect than odor, although evil odors seemed to have definite inhibitory effects The sight and the taste of food whether or not the odor is perceived, are of identical influence It was found that reading a newspaper during the meal had no effect on gastric activity, while anxiety or mental strain materially delayed digestion

Table 30 Table of Digestibility of the Commoner Foods (Assembled from the Experiments of Hawk and His Associates)

| | Rapid Emptying of Stomach | Slow Emptying of Stomach | Average Acidity |
|---|---|---|---|
| Beef | 2 hr 35 min | 3 hr 35 min | 120 |
| Pork | 2 hr 45 min | 3 hr 40 min | 117 |
| Lamb | 2 hr 30 min | 3 hr 20 min | 134 |
| Eggs | 2 hr 15 min | 3 hr 5 min | 80 |
| Vegetables | 2 hr 0 min | 2 hr 30 min | 70 to 77 |
| Puddings | 2 hr 18 min | | 92 |
| Pies | 2 hr 27 min | | 90 |
| Cakes | 3 hr 2 min | | 90 |

A different approach to this subject, by means of the fluoroscope was made by the British investigators Maile and Scott [26] They found that the additon of 1 ounce of barium sulfate to the ordinary mixed meal permitted good visualization and did not appreciably influence the emptying time Adopting this procedure, they studied the behavior of the stomach after the taking of food either as a single article or as a mixed meal On the basis of these studies they reached conclusions which are somewhat at variance with those of the previously quoted American investigators They state

1 An ordinary meal leaves the stomach in about four hours A very large meal may be retained for five hours 2 A meal not necessarily large but containing much butter or cream is retained in the stomach for a longer period 3 Concentrated carbohydrates such as sugar leave the stomach much more quickly than natural carbohydrates such as banana or potato 4 Cooking shortens the time of stomach digestion of some foods and increases it for others 5 The length of stomach digestion of different foods cannot be taken as a measure of their digestibility 6 Fat in abnormal proportions causes the stomach emptying time to be prolonged to a very marked degree 7 The sensation of hunger does not appear to be dependent on vigorous peristalsis

The *amount of residue* remaining in the intestine after digestion has been extensively studied by a group of workers at the Mayo Clinic Hosoi Alvarez and Mann[27] produced in dogs an anastomosis between the terminal part of the ileum and the lower part of the rectum and were enabled in this way to study food residues They took the percentage relationship between the moist weight of the feces and the moist weight of the food as an index of the efficiency of digestion In their

Table 32 Severe Reactions of 500 Patients to Food, with Symptoms Such as Vomiting Diarrhea or Severe Pain (Alvarez and Hinshaw)

| | Per cent | Cases | | Cases |
|---|---|---|---|---|
| Milk cream and ice cream | 7 | 34 | Peanuts | 4 |
| Chocolate | 5 | 25 | Pork | 4 |
| Apples (raw) | 4 | 19 | Strawberries | 4 |
| Onions (raw usually) | 3 | 17 | Raw fruits | 4 |
| Eggs | 3 | 15 | Lobster | 4 |
| Tomatoes | 3 | 15 | Veal | 4 |
| Cabbage (cooked) | 2 | 12 | Dried beans | 3 |
| Meat beef and beef fat | 2 | 11 | Cucumbers | 3 |
| Corn | 2 | 11 | Oranges | 3 |
| Coffee | 2 | 8 | Radishes | 3 |
| Bananas | 2 | 8 | Sweets | 3 |
| Nuts | 1 | 6 | Peas | 3 |
| Cauliflower | 1 | 5 | Fats | 2 |
| Cantaloupe | 1 | 5 | Peppers | 2 |
| Fish | 1 | 5 | Pickles and sour foods | 2 |
| Chicken and chicken broth | 1 | 5 | Spinach | 2 |
| Watermelon and melons | 1 | 5 | Oat meal | 2 |
| Cheese | 1 | 5 | Sauerkraut | 2 |
| Lettuce | | 4 | | |

The following foods were each complained of once

| | | |
|---|---|---|
| Wheat | Chili peppers | Okra |
| Potato | Brazil nuts | Vinegar |
| Butter | Walnuts | Cranberries |
| Coca Cola | Broccoli | Raspberries |
| Rhubarb | Shrimp | Asparagus |
| Sprouts | Oysters | Vienna sausage |
| Eggplant | Crab | Green beans |
| Mushrooms | Scallops | Garlic |
| Pepper | Grapes | |

Table 33 Foods Blamed by 157 among 400 Patients, Who Complained of Gas Belching, Flatulence or Distention (Alvarez and Hinshaw)

| | Per Cent of 157 | | Per Cent of 157 |
|---|---|---|---|
| Onions | 36 | Strawberries | 7 |
| Cabbage | 34 | Pork | 6 |
| Apples | 32 | Meat and beef | 6 |
| Radishes | 21 | Bananas | 5 |
| Dried beans | 17 | Pickles and sour foods | 5 |
| Cucumbers | 16 | Corn | 4 |
| Milk cream ice cream | 16 | Peppers | 4 |
| Fats rich foods | 13 | Nuts | 4 |
| Cantaloupe | 11 | Salmon | 3 |
| Cauliflower | 11 | Spices | 3 |
| Chocolate | 11 | Cheese | 3 |
| Coffee | 11 | Peas | 3 |
| Lettuce | 11 | Prunes | 3 |
| Watermelon and melons | 10 | Sweets | 3 |
| Peanuts | 9 | Ginger ale | 2 |
| Eggs | 8 | Sour foods | 2 |
| Oranges | 8 | Sweet potato | 2 |
| Tomatoes | 8 | Beer | 2 |

**Table 34 Foods Blamed by 98 among 400 Patients Who Complained of Regurgitation, Lingering 'Taste or Repeating" (Alvarez and Hinshaw)**

| | Per Cent of 98 | | Per Cent of 98 |
|---|---|---|---|
| Onions | 22 | Cauliflower | 6 |
| Radishes | 20 | Strawberries | 6 |
| Cantaloupe | 20 | Meat | 6 |
| Cucumbers | 17 | Milk | 6 |
| Cabbage | 15 | Chocolate | 5 |
| Lettuce | 10 | Peppers | 5 |
| Fats etc | 10 | Bananas | 4 |
| Watermelon and melons | 8 | Salmon | 3 |
| Apples | 8 | Celery | 3 |
| Eggs | 8 | Beans | 2 |
| Tomatoes | 8 | Cheese | 2 |
| Coffee | 7 | Nuts | 2 |
| Oranges | 7 | Sweets | 2 |

**Table 35 Number of Complaints Lodged against Each Food during an Investigation of 400 Patients (Not Pregnancies) (Alvarez and Hinshaw)**

| | Total No of Complaints | Vomiting Diarrhea | Gas Belching | Heartburn | Regurgitation | Headache |
|---|---|---|---|---|---|---|
| Onions | 120 | 15 | 56 | 10 | 22 | 10 |
| Milk cream ice cream | 114 | 27 | 25 | 3 | 6 | 5 |
| Apples | 107 | 15 | 50 | 7 | 8 | 2 |
| Cabbage | 101 | 12 | 54 | 4 | 15 | 3 |
| Chocolate | 76 | 19 | 17 | 2 | 5 | 14 |
| Radishes | 75 | 3 | 33 | 5 | 20 | 1 |
| Tomatoes | 58 | 11 | 12 | 12 | 8 | 1 |
| Cucumbers | 56 | 2 | 25 | 1 | 17 | 2 |
| Eggs | 56 | 10 | 12 | 3 | 8 | 3 |
| Fats rich foods | 51 | 2 | 21 | 3 | 10 | 2 |
| Cantaloupe | 51 | 5 | 17 | 2 | 20 | 0 |
| Meat and beef | 44 | 7 | 9 | 1 | 6 | 2 |
| Beans (dried) | 41 | 3 | 27 | 0 | 2 | 0 |
| Watermelon and melons | 38 | 5 | 15 | 2 | 8 | 0 |
| Strawberries | 38 | 4 | 11 | 1 | 6 | 0 |
| Coffee | 37 | 5 | 17 | 5 | 7 | 2 |
| Cauliflower | 34 | 5 | 17 | 0 | 6 | 0 |
| Pork | 33 | 4 | 9 | 4 | 0 | 3 |
| Lettuce | 30 | 1 | 17 | 1 | 10 | 0 |
| Corn | 29 | 9 | 7 | 0 | 0 | 1 |
| Bananas | 29 | 8 | 8 | 3 | 4 | 1 |
| Pickles and sour foods | 29 | 2 | 8 | 3 | 1 | 0 |
| Oranges | 26 | 3 | 12 | 10 | 7 | 2 |
| Peanuts | 25 | 2 | 14 | 1 | 1 | 4 |
| Spices | 22 | 0 | 5 | 4 | 1 | 1 |
| Sweets | 21 | 3 | 4 | 3 | 2 | 0 |
| Nuts (various kinds) | 21 | 2 | 6 | 0 | 2 | 0 |

The recognition of the particular food to which a person is allergic is not always easy Cutaneous tests are a disappointment and are seldom to be relied upon The same applies to other forms of food

idiosyncrasy, and in this as in many other fields there is no short cut to diagnosis The use of elimination diets is often of help but as a rule, painstaking questioning of the patient who has been prompted to intelligent observation brings the best results Alvarez and Hinshaw,[29] after questioning a large number of patients in this manner prepared the tables reproduced herewith (Tables 31 to 35)

## THE COST OF FOOD

The housewife who, while living within a narrowly limited budget wishes to provide her family with the optimum diet must have a working knowledge of both the monetary value and the nutritional value of available foods The same applies also to dietitians and to social workers The profound changes in the supply and consequently in the cost of food produced by World War II with the disturbing increases in cost that have continued necessitate many revisions in household economy This trend in food prices is illustrated by the studies of Phipard and Stiebeling[30] All that is written today concerning the cost of food and its availability must be interpreted in the light of these changes To follow a low cost food plan prepared by the Bureau of Human Nutrition and Home Economics a family of four might have spent per week at average city prices

| | |
|---|---|
| June 1936 | $ 9 00 $10 00 |
| June 1942 | 10 00 11 00 |
| June 1945 | 13 00 14 00 |
| June 1948 | 18 00 20 00 |
| June 1951 | 19 00 21 00 |

*Cost* is by no means a fair criterion of nutritive value for it is influenced by many factors the perishable nature of the food, its scarcity the distance it must be transported, its appearance and attractiveness and the package in which it is sold all have a bearing on its market value Thus the perishable nature of fresh meat is one reason for its high cost the more desirable cuts give less food for the same money lettuce in winter and fruit out of season are expensive and large red apples and foods in fancy packages cost more than an equal quantity of the same food in less attractive form It is important that food present a pleasing appearance on the table but attractiveness on the market often is not worth the money it brings When strict economy is necessary articles with fortuitous or artificial values should be avoided The pamphlet issued by the American Meat Institute of Chicago and approved by the Council on Foods and Nutrition of the American Medical Association under the title Buying Guide to the Thriftier Cuts of Meat gives dependable information

In arranging the dietary and in purchasing food the housewife should consider the relation of cost to the following factors (*a*) fuel value (*b*) protein content (*c*) mineral and vitamin content and (*d*) palatability and attractiveness Since dietaries are likely to be faulty in respect to their mineral and vitamin content it is best that she reverse the usual order she should first of all secure an adequate supply of these two factors and then devote her attention to caloric content and protein values

**Table 36. Consumption of Specified Food Groups** Average quantity of specified groups of food consumed at home per person per week by type of community and annual net money income class housekeeping families and single persons in the United States spring 1942[a] (Sherman[31])

| Type of Community and Annual Net Money Income Class (Dollars) | Average Quantity Consumed per Person per Week | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Milk[b] | Potatoes Sweet Potatoes | Dry Beans and Peas Nuts[c] | Green and Yellow Vegetables | Tomatoes Citrus Fruit | Other Vegetables and Fruit[d] | Meat Poultry Fish[e] | Eggs | Grain Products[f] | Fats Oils[g] | Sugars Sweets |
| | Quarts | Pounds | Pounds | Pounds | Pounds | Pounds | Pounds | Dozens | Pounds | Pounds | Pounds |
| **URBAN** | | | | | | | | | | | |
| All classes[h] | 3 83 | 2 66 | 0 27 | 2 36 | 3 33 | 3 32 | 2 77 | 0 65 | 2 96 | 1 12 | 0 87 |
| 0-499 | 2 86 | 3 11 | 43 | 1 81 | 1 79 | 2 60 | 1 65 | 51 | 3 14 | 1 12 | 80 |
| 500-999 | 3 24 | 2 48 | 35 | 2 29 | 2 21 | 2 89 | 2 07 | 58 | 3 14 | 1 15 | 83 |
| 1000-1499 | 3 47 | 2 58 | 37 | 2 20 | 2 73 | 3 09 | 2 22 | 63 | 3 16 | 1 15 | 91 |
| 1500-1999 | 4 02 | 2 74 | 26 | 2 23 | 2 75 | 2 94 | 2 43 | 71 | 2 82 | 1 18 | 81 |
| 2000 2999 | 3 93 | 2 71 | 27 | 2 44 | 3 60 | 3 54 | 2 99 | 69 | 2 98 | 1 08 | 92 |
| 2000-2499 | 3 84 | 2 77 | 24 | 2 38 | 3 44 | 3 42 | 2 85 | 69 | 3 06 | 1 10 | 96 |
| 2500-2999 | 4 06 | 2 63 | 30 | 2 52 | 3 82 | 3 71 | 3 19 | 70 | 2 87 | 1 05 | 86 |
| 3000 or over[h] | 4 04 | 2 59 | 21 | 2 46 | 4 03 | 3 61 | 3 24 | 65 | 2 88 | 1 11 | 86 |
| 3000-4999 | 4 07 | 2 60 | 22 | 2 36 | 3 95 | 3 48 | 3 21 | 67 | 2 96 | 1 10 | 85 |
| 5000-9999 | 4 02 | 2 69 | 18 | 2 62 | 3 83 | 3 73 | 3 32 | 60 | 2 75 | 1 11 | 87 |
| **RURAL NONFARM** | | | | | | | | | | | |
| All classes[i] | 4 05 | 2 97 | 49 | 1 83 | 2 04 | 2 72 | 1 76 | 66 | 4 49 | 1 22 | 1 14 |
| 0-499 | 3 59 | 2 67 | 55 | 1 67 | 1 49 | 2 24 | 1 10 | 57 | 5 37 | 1 29 | 1 11 |
| 500-999 | 3 52 | 2 77 | 52 | 1 64 | 1 80 | 2 24 | 1 54 | 55 | 5 22 | 1 26 | 1 17 |
| 1000-1499 | 3 97 | 3 33 | 54 | 1 73 | 1 72 | 2 63 | 1 61 | 66 | 4 17 | 1 16 | 1 16 |
| 1500-1999 | 4 50 | 3 21 | 45 | 1 74 | 2 26 | 3 15 | 2 08 | 72 | 3 98 | 1 22 | 1 09 |
| 2000-2999 | 4 42 | 3 02 | 44 | 2 16 | 2 61 | 3 01 | 2 21 | 73 | 4 03 | 1 19 | 1 18 |
| 3000 or over | 4 88 | 2 74 | 45 | 2 50 | 3 17 | 3 67 | 2 62 | 84 | 3 42 | 1 14 | 1 06 |
| **RURAL FARM** | | | | | | | | | | | |
| All classes[i] | 5 71 | 3 26 | 45 | 1 83 | 1 64 | 2 81 | 1 83 | 69 | 4 71 | 1 35 | 1 41 |
| 0 499 | 5 26 | 2 76 | 51 | 1 94 | 1 14 | 2 29 | 1 44 | 55 | 5 04 | 1 29 | 1 36 |
| 500-999 | 5 59 | 3 38 | 47 | 1 82 | 1 59 | 2 97 | 1 73 | 64 | 5 13 | 1 38 | 1 65 |
| 1000 1499 | 5 95 | 4 36 | 51 | 1 81 | 1 86 | 3 51 | 2 28 | 75 | 4 27 | 1 36 | 1 39 |
| 1500-1999 | 6 40 | 4 10 | 32 | 2 01 | 3 30 | 3 69 | 2 29 | 83 | 4 07 | 1 43 | 1 45 |
| 2000 2999 | 5 62 | 3 86 | 38 | 1 64 | 2 94 | 3 29 | 2 46 | 1 00 | 3 93 | 1 31 | 1 50 |
| 3000 or over | 5 85 | 3 97 | 25 | 1 69 | 2 38 | 3 30 | 2 61 | 80 | 3 37 | 1 28 | 1 25 |

[a] The [illegible]

lent in minerals and protein

[c] Includes the dry weight of cooked or canned dry beans, peas and lentils, such as baked beans Includes the shelled weight of nuts

[d] Includes the fresh fruit equivalent of dried fruit

[e] Excludes bacon and salt pork

[f] Includes two-thirds of the weight of commercially baked goods added to the weight of flours, meal and cereals

[g] Includes bacon and salt pork

[h] Includes families with incomes of $10 000 or over, not shown separately

[i] Includes families with negative incomes not shown separately

In the selection of protein foods the quality of the protein as well as the cost must be considered The grains and certain of the vegetables especially the legumes form economical sources of protein but their biologic value is low, *and such proteins should* be supplemented by those of higher quality such as are found in milk

The *food budgets* of families with low incomes during the fourteen years from 1914–1915 to 1928–1929 as studied by Gillett and Rice of the New York Association for Improving the Condition of the Poor showed progressive movement This was attributed in part to the educational work of the staff of the Association and in part to a general trend toward the more intelligent selection of food The opportunities for such improvement were clearly revealed by Sherman in his intensive study of the dietaries of 224 representative American families Significant among these observations was the almost invariable tendency of families in the lower income brackets to include in the ration preponderating amounts of breadstuffs and other grain products and thus to secure from small monetary outlays relatively large values in protein and total calories Sherman points out that such a diet is usually low in calcium and in vitamin A and riboflavin but that this can be corrected by the addition of milk and milk products

The *studies of Sherman emphasize the fact that the typical* American diet can easily be improved through greater emphasis upon milk vegetables and fruits Indeed when expenditures are forced to an extremely low level this need for milk becomes still more urgent Sherman says that one can forego fish flesh and fowl and can do without sweets and the shortened products of the bakery as well as the miscellaneous foods bought from the grocery provided one takes enough milk and sufficient *fruits or vegetables to supply the minimal requirement* of vitamins and minerals and if in addition there is included in this ration enough breadstuff to prevent actual weakness from hunger

Recognizing that milk is a bargain in food values the generally accepted rule is that the family diet should provide a quart of milk a day for each child and a pint for each adult Sherman states that the following rules suggested by him years ago have stood the test of time *(1) At least as much should be spent for milk* (including cream and cheese if used) as for meats poultry and fish and (2) at least as much should be spent for fruits and vegetables as for meats poultry and fish He also quotes the following suggestion of the Food Administration based apparently upon the experience in New York of *Miss Gillett*

Divide your money into fifths

- 1/5 more or less for vegetables and fruits
- 1/5 or more for milk and cheese
- 1/5 or less for meats fish and eggs
- 1/5 or more for bread and cereals
- 1/5 or less for fats sugar and other groceries and food adjuncts

*Dry skim milk* will meet the requirements of the restricted food budget better than liquid milk for it is more economical and at the same time supplies all the nutritive elements except vitamin A and fat found in the fresh article *This is illustrated* in the accompanying table

and curves (Table 37 and Fig 5) prepared by Kramer and Kunerth [32] They state in this regard.

In a small city in Kansas fresh whole milk retails at $0 10 per quart, while pasteurized skim milk of good grade costs $0 15 per gallon The curves show that money spent for skim milk at this price buys two and one half times as much calcium and phosphorus as the same sum spent for fresh whole milk In the same community money spent for dry skim milk obtained on a cooperative basis for about $0 09 per pound buys five times as much of the valuable milk proteins recommended for border line diets as would the same amount spent for whole milk

Table 37 Costs of 1 Gm Protein, Calcium or Phosphorus from Different Forms of Cow's Milk When the Market Unit Was Priced at $0 10 (Kramer and Kunerth[32])

| Form of Cow s Milk | Market Unit | Cost of 1 Gram | | |
|---|---|---|---|---|
| | | Protein | Calcium | Phosphorus |
| Whole milk, fresh | 1 quart | $0 0031 | $0 0855 | $0 1103 |
| Skim milk, fresh | 1 quart | $0 0030 | $0 0840 | $0 1068 |
| Whole milk, dried | 1 pound | $0 0009 | $0 0241 | $0 0309 |
| Skim milk, dried | 1 pound | $0 0006 | $0 0166 | $0 0209 |
| Evaporated milk (unsweetened) | 1 tall can | $0 0035 | $0 1001 | $0 1294 |

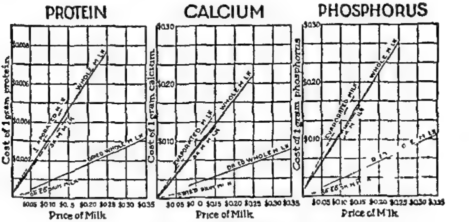


Fig 5 Cost of 1 gm protein calcium or phosphorus from various forms of milk
The cost of milk is for 1 quart whole or skim milk fresh
1 pound dried whole or dried skim milk
1 can (14½ oz) evaporated milk

## How to Figure Servings[33]

### *Milk*

Use at least this much every day For a child three to four cups an expectant mother four cups a nursing mother six cups other adults about three cups (A quart of fluid milk makes four cups)

The following can be counted the same as a quart of fluid whole milk 17 ounces (by weight) evaporated milk 1 quart skim milk and 1½ ounces (3 tablespoons) butter, 5 ounces (about ⅓ pound) American cheese

Table 38. Master Food Plan at Low Cost Weekly Quantities of Food (as Purchased) for 19 Age, Sex, and Activity Groups (U S Dept Agriculture[33])

| Family Members | Leafy Green and Yellow Vegetables | Citrus Fruit Tomatoes | Potatoes Sweet Potatoes | Other Vegetables and Fruit | Milk[1] | Meat Poultry Fish | Eggs | Dry Beans and Peas Nuts | Flour Cereals[2] | Fats and Oils[3] | Sugar Sirups Preserves |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lb Oz | Lb Oz | Lb Oz | Lb Oz | Qt | Lb Oz | No | Lb Oz | Lb Oz | Lb Oz | Lb Oz |
| Children through 12 years | | | | | | | | | | | |
| 9 12 months | 1— 8 | 1—12 | 0—8 | 1— 0 | 6 | 0— 4 | 5 | 0— 1 | 0—10 | 0— 1 | 0— 1 |
| 1-3 years | 1—12 | 1—12 | 1—0 | 1— 0 | 5½ | [4]0— 8 | 5 | 0— 1 | 1— 4 | 0— 2 | 0— 2 |
| 4 6 years | 1—12 | 1—12 | 1—8 | 1— 4 | 5½ | 1— 0 | 5 | 0— 2 | 1—12 | 0— 6 | 0— 6 |
| 7-9 years | 2— 0 | 2— 0 | 2—8 | 1— 8 | 5½ | 1— 8 | 5 | 0— 4 | 2— 4 | 0— 8 | 0—10 |
| 10-12 years | 2— 4 | 2— 4 | 3—0 | 1—12 | 6 | 1—12 | 5 | 0— 4 | 3— 4 | 0—12 | 0—12 |
| Girls | | | | | | | | | | | |
| 13-15 years | 2— 4 | 2— 4 | 3—4 | 1—12 | 6½ | [4]2— 0 | 5 | 0— 4 | 3— 8 | 0—12 | 0—12 |
| 16 20 years | 2— 4 | 2— 4 | 3—0 | 1—12 | 5 | [4]2— 0 | 5 | 0— 4 | 3— 4 | 0—12 | 0—10 |
| Boys | | | | | | | | | | | |
| 13-15 years | 2— 8 | 2— 8 | 4—0 | 2— 4 | 6½ | 2— 0 | 5 | 0— 8 | 4— 8 | 1— 0 | 0—14 |
| 16-20 years | 2—12 | 2— 8 | 5—0 | 2— 8 | 6½ | 2— 0 | 5 | 0— 8 | 5—12 | 1— 6 | 1— 0 |
| Women | | | | | | | | | | | |
| Sedentary | 2— 4 | 2— 0 | 2—4 | 1—12 | 5 | 2— 0 | 5 | 0— 4 | 2— 0 | 0—10 | 0—10 |
| Moderately active | 2— 4 | 2— 0 | 3—0 | 1—12 | 5 | 2— 0 | 5 | 0— 4 | 3— 4 | 0—12 | 0—12 |
| Very active | 2— 8 | 2— 8 | 4—0 | 2— 0 | 5 | 2— 0 | 5 | 0— 6 | 4— 4 | 1— 0 | 1— 0 |
| Pregnant | 3— 0 | 2— 8 | 2—8 | 2— 0 | 7½ | [4]2— 4 | 7 | 0— 4 | 2— 8 | 0—10 | 0— 8 |
| Nursing | 3— 8 | 3—12 | 4—0 | 2— 4 | 10½ | [4]2— 8 | 7 | 0— 4 | 3— 0 | 0—10 | 0— 8 |
| 60 years or over[5] | 2— 8 | 2— 4 | 2—8 | 1—12 | 5 | 2— 0 | 4 | 0— 2 | 2— 4 | 0— 8 | 0— 8 |
| Men | | | | | | | | | | | |
| Sedentary | 2— 4 | 2— 0 | 3—0 | 1—12 | 5 | 2— 0 | 5 | 0— 4 | 3— 4 | 0—12 | 0—12 |
| Physically active | 2— 8 | 2— 8 | 4—0 | 2— 0 | 5 | 2— 0 | 5 | 0— 6 | 4— 4 | 1— 0 | 1— 0 |
| With heavy work | 2— 8 | 2— 8 | 6—0 | 2— 8 | 5 | 2— 0 | 5 | 0—10 | 7—12 | 1—14 | 1— 0 |
| 60 years or over[5] | 2— 8 | 2— 4 | 3—4 | 1—12 | 5 | 2— 0 | 4 | 0— 2 | 3— 4 | 0—10 | 0—10 |

1 Or its equivalent in cheese, evaporated milk or dry milk

2 Count 1½ pounds of bread as 1 pound of flour. Use as much as possible in the form of whole grain enriched, or restored products

3 For small children and pregnant and nursing women cod liver oil or some other source of vitamin D is also needed For elderly persons and for persons who have no opportunity for exposure to clear sunshine, a small amount of vitamin D is also desirable

4 1 large or 2 small servings of liver or other organ meats should be served each week.

5 The nutritive content of the weekly food quantities for a man and a woman 60 years or over were based on the National Research Council s recommended daily allowances for the sedentary man and woman

## *Potatoes, Sweet Potatoes*

Serve eleven or twelve times a week by low cost plan, nine or ten times by moderate cost plan

One pound makes three or four servings

## *Dry Beans and Peas, Nuts*

Serve three or four times a week by low cost plan, one or two times by moderate cost plan

One pound (two cups) of dry beans or peas equals five to six cups when cooked and makes eight to ten servings

**Table 39 Master Food Plan at Moderate Cost Weekly Quantities of Food (as Purchased) for 19 Age, Sex, and Activity Groups (U S Dept Agriculture[33])**

| Family Members | Leafy Green and Yellow Vegetables | Citrus Fruit Tomatoes | Potatoes Sweet Potatoes | Other Vegetables and Fruit | Milk[1] | Meat Poultry Fish | Eggs | Dry Beans and Peas Nuts | Flour Cereals[2] | Fats and Oils[3] | Sugar Sirups Preserves |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lb Oz | Lb Oz | Lb Oz | Lb Oz | Qt | Lb Oz | No | Lb Oz | Lb Oz | Lb Oz | Lb Oz |
| Children through 12 years | | | | | | | | | | | |
| 9-12 months | 1— 8 | 1—12 | 0— 8 | 1— 0 | 6 | 0— 4 | 5 | 0—1 | 0—10 | 0— 1 | 0— 1 |
| 1 3 years | 2— 0 | 2— 0 | 0— 8 | 1—12 | 6 | [4]0—12 | 6 | 0—1 | 1— 4 | 0— 2 | 0— 2 |
| 4-6 years | 2— 4 | 2— 4 | 1— 0 | 2— 4 | 6 | 1— 4 | 7 | 0—1 | 1— 8 | 0— 6 | 0— 8 |
| 7 9 years | 2— 8 | 2— 8 | 1—12 | 2— 8 | 6½ | 1—12 | 7 | 0—2 | 2— 0 | 0— 8 | 0—12 |
| 10-12 years | 3— 0 | 2—12 | 2— 4 | 2— 8 | 7 | 2— 4 | 7 | 0—2 | 2—12 | 0—12 | 0—14 |
| Girls | | | | | | | | | | | |
| 13 15 years | 3— 8 | 2—12 | 2— 8 | 3— 8 | 7 | [4]2—12 | 7 | 0—2 | 2—12 | 0—14 | 0—14 |
| 16 20 years | 3— 8 | 2—12 | 2— 8 | 3— 8 | 6 | [4]2—12 | 7 | 0—2 | 2— 8 | 0—12 | 0—14 |
| Boys | | | | | | | | | | | |
| 13 15 years | 3— 8 | 3— 0 | 3— 8 | 3— 8 | 7 | 3— 0 | 7 | 0—4 | 4— 0 | 1— 2 | 1— 2 |
| 16 20 years | 4— 0 | 3— 8 | 4— 8 | 3— 8 | 7 | 3— 4 | 7 | 0—6 | 5— 4 | 1— 6 | 1— 4 |
| Women | | | | | | | | | | | |
| Sedentary | 3— 4 | 2— 8 | 1—12 | 3— 4 | 5 | 2— 8 | 7 | 0—1 | 1—12 | 0—10 | 0—12 |
| Moderately active | 3— 8 | 2— 8 | 2— 8 | 3— 8 | 5 | 2—12 | 7 | 0—2 | 2— 8 | 0—14 | 0—14 |
| Very active | 3—12 | 3— 0 | 3— 4 | 4— 0 | 5 | 3— 0 | 7 | 0—4 | 3—12 | 1— 2 | 1— 2 |
| Pregnant | 4— 0 | 3— 8 | 2— 4 | 3— 0 | 7½ | [4]3 0 | 7 | 0—2 | 2— 4 | 0—10 | 0—10 |
| Nursing | 4— 0 | 4— 8 | 3— 0 | 3— 8 | 10½ | [4]3— 0 | 7 | 0—2 | 2— 8 | 0—12 | 0—12 |
| 60 years or over[5] | 3— 8 | 2—12 | 2— 0 | 3— 0 | 5½ | 2— 8 | 6 | 0—1 | 1—12 | 0— 8 | 0—10 |
| Men | | | | | | | | | | | |
| Sedentary | 3— 8 | 2— 8 | 2— 8 | 3— 8 | 5 | 2—12 | 7 | 0—2 | 2— 8 | 0—14 | 0—14 |
| Physically active | 3—12 | 3— 0 | 3— 4 | 4— 0 | 5 | 3— 0 | 7 | 0—4 | 3—12 | 1— 2 | 1— 2 |
| With heavy work | 4— 0 | 3— 8 | 5— 0 | 4— 4 | 5 | 3— 8 | 7 | 0—6 | 7— 0 | 2— 0 | 1— 4 |
| 60 years or over[5] | 3— 8 | 2—12 | 2—12 | 3— 0 | 5½ | 2—12 | 6 | 0—2 | 2— 8 | 0—12 | 0—12 |

[1] Or its equivalent in cheese evaporated milk or dry milk

[2] Count 1½ pounds of bread as 1 pound of flour Use as much as possible in the form of whole grain enriched or restored products

[3] For small children and pregnant and nursing women cod liver oil or some other source of vitamin D is also needed For elderly persons and for persons who have no opportunity for exposure to clear sunshine a small amount of vitamin D is also desirable

[4] 1 large or 2 small servings of liver or other organ meats should be served each week

[5] The nutritive content of the weekly food quantities for a man and a woman 60 years or over were based on the National Research Council s recommended daily allowances for the sedentary man and woman

### *Citrus Fruits, Tomatoes*

Serve at least this often A child under four once a day an expectant mother six or seven times a week a nursing mother once or twice a day *others in the family four or five times a week*

Number of servings to the pound Fresh oranges or grapefruit as is or juiced—two to three canned oranges or grapefruit in sections or as juice—about four fresh tomatoes—three to four canned tomatoes whole or as juice—about four

There is more vitamin C in citrus fruit than in tomatoes Thus if tomatoes alone are used to supply vitamin C half again as much should be used as is recommended in the weekly list

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27 Hosoi K, Alvarez, W C., and Mann F. C. Intestinal Absorption A Search for a Low Residue Diet Arch Int Med, 41 112, 1928

28 Childrey, J H Alvarez, W C and Mann F C Digestion Efficiency with Various Foods and under Various Conditions Arch Int Med 46 361, 1930

29 Alvarez W C., and Hinshaw H C Foods That Commonly Disagree with People J A M.A, 104 2053 1935

30 Phipard E T, and Stiebeling H K Adequacy of American Diets in Handbook of Nutrition Council on Foods and Nutrition, American Medical Association Philadelphia, Blakiston 1951 p 599

31 Sherman, H C Family Food Consumption in the United States Misc Pub No 550 United States Department of Agriculture, 1944

32 Kramer, M M, and Kunerth, B L Relative Economy of Different Forms of Milk as Sources of Protein, Calcium, and Phosphorus J Am Dietet A 11 318 1935

33 Bureau of Human Nutrition and Home Economics, United States Department of Agriculture Misc Pub No 662 Sept 1951

34 Bureau of Human Nutrition and Home Economics United States Department of Agriculture June 1951

# 8

## Milk and Milk Products

### MILK

Milk is the most important of all foods It is indispensable to the infant it is essential to the proper development of the young child and it should form invariably a major article of diet for the older child For the adult too it is always a valuable and at times a well nigh essential adjunct to the diet

**Physical Properties of Milk** Milk is a yellowish white liquid of sweet ish taste and characteristic odor It is an emulsion containing protein sugar mineral salts other substances and fat When milk is permitted to stand the droplets rise to the top in the form of cream The specific gravity of milk averages 1 033 its freezing point –0 546° C Its reaction is just on the acid side of neutrality with a *p*H 6 5

**Chemistry of Milk** The composition of milk is influenced in a small degree by breed course of lactation season ration and the individual characteristics of the cow The kind of fat as well as its amount is de termined to some extent by diet for foreign fats eaten by the cow may appear as such in the milk The disagreeable taste sometimes acquired by milk in the spring is due to certain weeds which have been eaten by the cow

The average composition of human milk cow s milk and goat s milk is given in Tables 41 and 42 [1]

The *proteins* of milk are of the highest quality that is they supply all the amino acids necessary for successful nutrition They rank in this respect with the proteins of meat and are superior to those of grains and vegetables Milk proteins are of good supplementary value also for when added to those of wheat or other grains they enhance the nutritive value of the ration and render adequate a diet which would otherwise be faulty in respect to its amino acid content Skim milk added to the corn ration of swine makes an ideal food and promotes excellent growth The nutritive value of man s diet is greatly increased by the addition of milk to his cereals and by wheat bread

Milk contains several proteins three are well known—casein lact albumin and lactoglobulin The most important of these is casein be cause it not only is of high biologic value but it is five times more abun dant than the others and makes possible the preservation of milk pro

**Table 41 Average Values for Human Colostrum, Transitional and Mature Milk, Mature Goat Milk and Mature Cow Milk***

| | Colostrum | | Mature Milk | | |
|---|---|---|---|---|---|
| | 1–5 Days | 5–10 Days | Human | Goat | Cow |
| Water, gm /100 ml whole milk | 87 | 86 | 88 | 86 | 87 |
| Energy, Calories/100 ml whole milk | 58 | 74 | 71 | 78 | 69 |
| ENERGY DISTRIBUTION | | | | | |
| (Calories per 100 ml whole milk) | | | | | |
| Energy values reported | 58 | 74 | 71 | 78 | 69 |
| Calculated Energy | | | | | |
| Fat (gm × 9 25) | 27 | 33 | 35 | 38 | 35 |
| Lactose (gm × 3 95) | 21 | 26 | 28 | 19 | 19 |
| Protein (gm × 5 65) | 15 | 9 | 7 | 19 | 19 |
| Total | 63 | 68 | 70 | 76 | 73 |
| Percentage from fat | 43 | 49 | 50 | 50 | 48 |
| Percentage from lactose | 33 | 38 | 40 | 25 | 26 |
| Percentage from protein | 24 | 13 | 10 | 25 | 26 |
| | 12 8 | 13 6 | 12 4 | 13 6 | 12 8 |
| | 2 9 | 3 6 | 3 8 | 4 1 | 3 8 |
| | 5 3 | 6 6 | 7 0 | 4 7 | 4 8 |
| | 2 7 | 1 6 | 1 2 | 3 4 | 3 3 |
| | 0 33 | 0 24 | 0 21 | 0 77 | 0 71 |
| | 31 | 34 | 34 | 130 | 126 |
| | 14 | 17 | 16 | 106 | 99 |
| | 74 | 64 | 55 | 181 | 138 |
| | 48 | 29 | 15 | 41 | 58 |
| | 0 12 | | 0 21 | 0 05 | 0 13 |
| | 0 06 | | 0 04 | 0 04 | 0 03 |
| | | | | | 0 00006 |
| | | | | | 0 016 |
| | 0 012 | 0 002 | 0 011 (skimmed milk) | | 0 021 |
| Zinc, mg /100 cc | 0 65 | 1 15 | 0 66 | | 0 35 |

* Bull National Research Council No 119 pp 55 59 (Jan ) 1950

teins and fat in the form of cheese Caseinogen, a phosphoprotein is the precursor of casein It is precipitated by dilute acids, but can be redissolved by an excess of acid It is also dissolved by alkalis In the souring and coagulation of milk which accompany the formation of *lactic acid, the isoelectric precipitation of casein is observed* Caseinogen is converted into casein by the enzyme rennin and is precipitated as calcium caseinate Lactalbumin and lactoglobulin are present in much smaller amounts

The *carbohydrate* of milk is lactose, or milk sugar Lactose is a disaccharide and is split on digestion into glucose and galactose one molecule of each It is not as sweet as cane sugar, this fact is made use of when, as in *the feeding of patients with typhoid fever*, it is desired to give a high caloric carbohydrate diet Lactose is an important factor in the souring of milk, under the influence of bacteria it ferments, with the production of lactic acid Its amount is constant

**Table 42 Average Vitamin Content of Human Colostrum, Transitional and Mature Milk, Mature Goat Milk and Mature Cow Milk***

| | Colostrum | | Mature Milk | | |
|---|---|---|---|---|---|
| | 1–5 Days | 5–10 Days | Human | Goat | Cow |
| Vitamins | | | | | |
| (Values per 100 ml whole milk) | | | | | |
| Fat soluble vitamins | | | | | |
| Vitamin A, mmg | 89 | 88 | 54 | | 37 |
| Carotenoids mmg | 112 | 38 | 32 | | 39 |
| Vitamin D U S P units | | | 0 42 | | |
| Vitamin E, mg | 1 28 | 1 32 | 0 66 | | 0 06 |
| Vitamin K, Dam Glavind units | | | 26 | | 100 |
| Water soluble vitamins | | | | | |
| Ascorbic acid mg | 4 4 | 5 4 | 4 4 | 1 3 | 1 8 |
| Biotin total, mmg | 0 1 | 0 4 | 0 4 | 6 3 | 3 5 |
| Choline, mg | | | 9 | | 13 |
| Choline, free, mg | | | 2 | | 4 |
| Folic acid mmg | | | 0 22 | | 0 29 |
| Inositol, total, mg | | | 39 | 21 | 13 |
| Inositol, free mg | | | 44 | | 6 |
| Nicotinic acid, mmg | 75 | 175 | 172 | 273 | 85 |
| Pantothenic acid mmg | 183 | 288 | 203 | 289 | 350 |
| Pyridoxine, mmg | | | 11 | 7 | 48 |
| Riboflavin, total, mmg | 31 1 | 36 9 | 46 9 | 114 | 158 |
| Riboflavin, free, mmg | 19 0 | 24 0 | 24 2 | | |
| Thiamine, total mmg | 19 | 6 | 15 | 48 | 42 |
| Thiamine free, mmg | 0 4 | 0 8 | 4 8 | 8 6 | 23 |

* Bull National Research Council No 119 p 63 (Jan) 1950

*Milk fat* consists of a mixture of fats in which the fatty acids tend to be distributed widely among the glycerides[2] The triglycerides of pal mitic oleic and butyric acids predominate The fat is emulsified in the form of extremely fine droplets from 2 to 4 microns in diameter, an enveloping membrane for these has been described The size of the droplet depends on the breed of the cow and determines the digestibility (or absorbability) of the fat Milk fat is produced by the milk glands, it may come directly from the fat of the blood or may arise through the conversion of dextrose into fat Its importance lies in part in the fact that it carries with it appreciable quantities of the fat soluble vitamin, especially of vitamin A Small amounts of lecithin and cholesterol are also found in milk When milk stands the fat rises to the top and is known as cream

The *mineral elements* of milk, in which are included, though not always in ideal amounts all the inorganic elements necessary to man, add greatly to its value Approximately 0 7 per cent of milk is ash The percentage of these elements in whole milk is found in Table 41 The most valuable of these elements to man is calcium It is needed by the growing child in large amounts and by the adult as well

human milk as closely as possible In certain countries the milk of ot animals is used particularly that of the goat of the mare and of t burro Burro's milk in many respects resembles mother s milk mo closely than does that of other animals although its fat content is rela tively low

The manner in which human milk differs from cow s milk is of par ticular interest The casein content of the former is less than that of the latter, although the amount of albumin is greater The relative propor tion of casein to albumin in human milk is 40 to 60 and in cow s milk 85 to 15 The casein of human milk is more difficult to precipitate both with acids and with salts even with rennin coagulation is more difficult than in cow s milk After precipitation with acids the casein of human milk is more easily redissolved by an excess of acid The coagulum of human milk is lighter than that of cow s milk and for this reason has been regarded as more digestible this belief is not universally accepted The fats of human milk are poorer in volatile fatty acids the droplets are larger The percentage of milk sugar is greater in human than in cow s milk Human milk is poorer in mineral matter, having only about one sixth as much calcium as cow s milk, but it is believed that the salts of the former are in a more utilizable form The iron content of human milk is almost twice that of cow s milk

## Nutritional Value of Milk

The great nutritional value of milk is due to the high quality of its proteins to its richness in mineral elements and vitamins and to the easy digestibility of its fats It protects against nutritional failure and there fore is classed among the protective foods Animal experiment has fur nished abundant proof of the importance of milk to the growing or ganism

In order to secure comparable evidence for man McCollum[5] carried out on a group of eighty four children a series of experiments covering a considerable period These children lived in an orphanage where sani tary conditions were satisfactory and the diet was adequate except that it was lacking in milk and green vegetables To the diet of each child in one subgroup of forty two there was added 1 quart of reconstituted milk (Klim) daily a control group of the same number received no milk The improvement in growth and well being of the former as com pared with that of the latter group was prompt and striking Many children increased 50 per cent in weight (one child, 90 per cent) during the first year of the experiment

Similar results were seen in the experiments conducted by Mann for the British Research Council upon a group of boys who were already receiving a seemingly adequate diet The addition of a pint of milk per day led not only to greater growth in height and weight but also to an increase in vigor alertness and buoyancy of spirit

The benefits which thus accrue from the inclusion of liberal amounts of milk in the diet were studied by Sherman upon several generations of experimental animals with results which led to the conclusion that

> starting with a dietary already adequate according to current standards an increase in the proportion of milk up to approximately the equivalent of a quart of milk per day for

every perso [illegible] and confers improved health and [illegible] ge in the same individuals in [illegible] It has also increased the average adult life cycle by about 10 per cent.

The amount of milk consumed by the adult has an important bearing both on the health of the community and on its wealth. It has been estimated that a pint of milk a day represents for the adult the minimum of nutritive safety and that a quart is the optimal amount; this includes not only milk taken as such, but also that used in cooking. The foregoing estimate comes from the combined experience of students of nutrition, of physicians and of various relief workers, all reaching the same conclusion from observations in widely differing fields. The consumption of milk in urban and suburban communities in America is far below this minimum. Improvement, however, in the milk supply and educational propaganda have led many communities to a steady increase in milk consumption, and the slogan "drink a quart of milk a day" is attracting ever increasing attention.

**Economy.** Milk is an economical food. The economy of using whey in the form of a powder is emphasized by Wilder; it is exceedingly cheap and carries valuable nutrients. To quote Haven Emerson: "Milk purchased even at the present higher level of prices is a bargain in food value." Even greater bargains in food value can be had in dry skim milk. This is an excellent food and when cost is to be considered is to be strongly recommended.

**Adulteration.** The adulteration of commercial milk for profit has been extensively practiced in the past, but, thanks to the rigid control exercised by public health officials, is rare today.

**Bacteria of Milk.** Milk which comes direct from the clean udder of a healthy cow contains few bacteria, perhaps only 500 or less per cubic centimeter. Contamination, however, takes place easily, for milk is an excellent culture medium and the organisms which gain access grow rapidly. The bacteria found in milk are as a rule nonpathogenic, but pathogenic varieties sometimes appear. Even those strains which are classed as nonpathogenic may cause grave illness in infants. The diseased udder of the cow may be responsible for streptococcal sore throat: extensive epidemics of this disease have been traced to milk infected from this source with *Streptococcus epidemicus.*[6] An infected dairy attendant —a typhoid carrier, for instance—is also a potential source of contamination.

**Milk Sickness.** The food of the cow can influence the composition of its milk to such an extent that it may impart not only disagreeable tastes and odors, but even extremely poisonous properties. This is illustrated in the disease, now fortunately rare, known as milk sickness (or, because of the weakness which it causes, "the trembles"), which comes from drinking the milk of a cow which has fed on the richweed.[7] The weakness experienced by these patients is extreme, and prolonged exertion may cause death. The condition is probably related to the remarkably low sugar content of the blood. There are also marked ketosis and lipemia. The nature of the poison is unknown.

## Regulations Concerning Milk

The Milk Ordinance and Code recommended by the United States Public Health Service recognizes three grades (A, B, and C) each of raw and pasteurized milk defined in relation to the sanitary precautions surrounding its production and the bacterial content of the milk The diversity of ordinances regulating the production and sale of milk has been revealed by a recent study of the sanitary milk and ice cream legislation in the United States sponsored by the National Research Council [8] The summary of the findings of this study bears quotation

This study included published laws and ordinances on milk sanitation of the 48 states and 84 of the 92 cities with populations of 100 000 or more from which information was received

The responsibility for enforcing the laws on milk sanitation in the states was established in either the department of health or the department of agriculture in about equal proportion In limited instances there was division of authority and in 2 states other departments were concerned *The city department of health was the responsible* agency at the local level except for a few city county health departments Nearly all of the state laws and city ordinances on sanitary milk control had been rewritten revised or amended since 1939 and a majority of them had been so modified since 1944

The Milk Ordinance and Code Recommended by the United States Public Health Service 1939 or 1949 Edition was followed in style and general details in about half of the states and cities It was the only ordinance recommended as a guide on a national basis The laws of 2 states established the sanitary provisions of the city ordinances except for a few selected items which were left to local decision City ordinances which followed no definite model showed the widest variation in requirements

The majority of states permitted the sale of retail raw milk and established 1 to 3 grades not including certified However only 37 states had established grades of milk Two states and 51 cities required all fluid milk to be pasteurized Most of the states provided for 1 to 3 grades of pasteurized milk but most of the cities limited pasteurized milk to 1 grade and only one third of the cities provided for enforcement by lowering the grade The most prevalent maximum bacterial count standard for the best grade of retail raw milk was 35 000 50 000 per ml Nine states had no designated bacterial count standard Some states and cities did not require that retail raw milk be produced from brucellosis free herds The most common bacterial count standard for the best grade of milk intended for pasteurization was 100 000 200 000 per ml and for the best grade of pasteurized milk 15 000 30 000 per ml

In connection with sanitary requirements for fluid cream the same general production processing and handling standards applied as for milk but the establishment of a bacterial standard for this product was less frequent In fact a number of states and cities indicated no specific bacterial count The permissible bacterial counts for cream were higher than those for milk

The written requirements for the frequency of sampling of milk and for the examination of milk samples other than for total bacterial count were rather limited Only a few state laws and city ordinances specified milk free from sediment and off flavor or required that pasteurized milk be phosphatase negative and comply with a coliform standard

On the dairy farms milk houses were required and were generally permitted to be an integral part of the barn In the majority of legislation hot water and wash vats were re[illegible]

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The majority however required milk to be cooled at or below 50° or 60° F

Within the milk pasteurization plant most regulations provided for separate rooms for certain plant processes detailed control of pasteurization and a pasteurization

standard of not less than 143° F for at least 30 minutes or 160° F for 15 seconds or both About one third of the states and four fifths of the cities required that the pouring lip of the bottle be protected by the cap Very few states and cities required a date of pasteurization or sale on the closure

About three fourths of all states had vested authority for sanitary ice cream laws in the department of agriculture but only 38 states had any sanitary ice cream legislation Only 24 of the 87 cities from which replies were received had any ordinance regulating the sanitation of ice cream The Frozen Desserts Ordinance and Code Recommended by the United States Public Health Service May 1940 Edition was followed by one third of the cities There was 1 state that restrained city health departments from enforcing the state law or passing their own ice cream ordinances

Only 4 state laws and 12 city ordinances exercised any control over ice cream ingredients Sanitary legislation for the control of ice cream mix prior to pasteurization was almost non existent The laws of 19 states and the ordinances of 20 cities established bacterial count standards for ice cream and the bacterial standards wherever established were generally 50 000 or 100 000 per ml or per gram

Most of the states and cities with sanitary ice cream legislation did have plant sanitation standards but only 40 per cent regulated counter freezers Indicating and recording thermometers were required by more than half of the states and cities that had legislation However only 30 states and 23 of the 87 cities had a pasteurization standard The pasteurization standards ranged through not less than 140° to 155° F for at least 30 minutes 160° to 161° F for 15 seconds and 170° to 172° F without a holding time

It is reasonable to assume that some variation in the enforcement of regulations occurs Obviously despite the greatly improved quality of the milk supply of the United States there is much to be done before all communities have the safest possible milk The physician has a responsibility in this matter and should see that he discharges it

## Pasteurization

Raw milk, if secured in a clean manner from healthy cows is fairly safe in a small community or on a farm where it is consumed soon after it is obtained But in modern complex civilization, milk must be transported long distances and kept a considerable time before it reaches the consumer, and during this period of transport and storage the contained bacteria are likely to multiply enormously *Therefore* anything which will kill these bacteria at the outset is helpful in rendering the milk safe This is what pasteurization does In this process milk is held for thirty minutes at a temperature of 142° to 145° F and is cooled immediately thereafter This kills the pathogenic organisms which may be present and increases the keeping qualities of the milk

Pasteurization is not intended to take the place of rigid sanitary control over the methods of production *it is merely an adjunct to this control* Dirty milk cannot be rendered clean by pasteurization but relatively clean milk can by this process be rendered safe *Milk which has been pasteurized should be kept cool and should be used within a reasonable time* Old pasteurized milk that is improperly handled can be dangerous

The heat to which milk is subjected during pasteurization destroys some of the vitamin C and causes minor chemical changes Except for this loss of ascorbic acid, pasteurization does not appreciably influence the nutritive qualities of the milk and even this does not detract from the value of the milk if orange juice, tomato juice or other substances rich in vitamin C are a part of the dietary

### Homogenized Milk

The digestibility of milk can be enhanced by the process known as homogenization The milk is forced under pressure through fine apertures as the result of which the size of the fat droplets is reduced greatly Such milk has the following advantages it is more easily digested because of the smaller size of the fat droplets to which it is attached the vitamin D is better utilized the fat globules do not rise to the top but remain suspended and the curd is smaller and more easily digested Many dairies have placed homogenized pasteurized milk on the market

## MILK PRODUCTS

**Butter** Butter contains the fat of the milk in semisolid form Good dairy butter contains about 90 per cent of fat 8 per cent of water and 2 per cent of salt casein lactose and other substances It also contains significant amounts of vitamin A and variable amounts of vitamin D The amount of casein and milk sugar in well washed butter is small the smaller the amount of the former the better the keeping qualities of the butter

Fresh butter has a pleasant aromatic odor which improves during the first few days of cold storage This attractive odor and flavor are due in part to diacetyl and also to certain other aromatic substances Its normal yellow color is dependent in large measure on the food of the cow in the spring this color is deeper It is the custom to add a little coloring matter in making butter

After a time butter tends to become rancid Salt is added ordinarily to freshly churned butter with the object of retarding its deterioration On the other hand Dahlberg [9] on the basis of his experiments states that unsalted butter keeps best and that salt hastens the appearance of the fishy flavor which old butter acquires He says Salt exclusive of its antiseptic qualities hastens the deterioration of butter The literature is full of contradictions It can be said with certainty however that fresh unsalted butter is more attractive and has the fine flavor of good butter to a higher degree than does the salted product and that if salt is added it should be in small amounts Anyone who has grown accustomed to unsalted butter will always prefer it

**Margarine** Margarine is prepared by blending animal or vegetable fats often partially hydrogenated with cultured skim milk for flavor Most margarine is now fortified with vitamin A Such margarine is the nutritional equivalent of butter Until recently discriminating taxes both federal and local have been levied against this food especially against the ready colored product Some of these taxes were repealed by a federal law in 1950 Many of the states have liberalized or are in the process of liberalizing their restrictive legislation on this good food product

### Fermented Milk

From time immemorial pastoral races have fermented the milk of their herds in order to preserve it and keep it palatable Usually this results in the formation of lactic acid and sometimes in alcoholic fer

mentation The fat remains unchanged the curd is broken into finely divided particles which are perhaps more digestible than those which form in the stomach and the milk sugar is converted largely into lactic acid or alcohol Because of the aroma of the lactic acid and the nature of the curd many persons prefer such milk invalids who do not easily retain milk are sometimes able to take the fermented varieties more comfortably than fresh milk

The best known of these is buttermilk It is the residue which remains in the churn after removal of the butter it contains all the constituents of milk except the fat It is frequently made by inducing fermentation in whole or skim milk through the addition of cultures of lactic acid bacilli Koumiss kefir matzoon yogurt acidophilus milk and similar fermentation products are made by the addition of certain strains of microorganisms to mare s milk or cow s milk The resulting fermentation imparts to the milk its peculiar sour flavor and other characters Such milks have a pleasant flavor and the invalid often finds in them a grateful substitute for the usual milk They are good foods but have none of the mysterious health giving virtues which are attributed to them by some present day food faddists

## Canned Milk

To preserve milk over long periods some method other than pasteurization must be adopted for this purpose various methods of canning have been devised

**Condensed Milk** This is made by adding 16 per cent of cane sugar to fresh milk heating for a short time at 160° to 180° F to dissolve the sugar and then evaporating in vacuo at 130° to 150° F until the milk has two fifths of the original volume and has a sugar content of about 40 per cent It must contain at least 8 per cent of fat and 28 per cent of milk solids In this process the milk is not completely sterilized but the high sugar content prevents the multiplication of bacteria Condensed milk in an unopened can will keep indefinitely Its sugar concentration prevents freezing in winter

**Evaporated Milk** This is made by evaporating fresh milk without the addition of sugar to about one half or two fifths of its original volume It is then placed in cans and heated by steam under pressure at a temperature sufficiently high to insure sterilization and to give it sufficient body to prevent the subsequent separation of the fat It must contain not less than 7 8 per cent of butter fat and 25 5 per cent of total milk solids

The heat to which the proteins and fats of evaporated milk have been subjected probably renders this milk more digestible than raw milk Evaporated milk can by the addition of water be reconstituted to approximately the same chemical composition as raw milk Most evaporated milk on the market contains added vitamin D in such quantity as to supply 400 units per reconstituted quart

**Dry Milk** Dry milk is a fine creamy white powder made of fresh milk from which the water has been removed There are two chief methods of manufacture either the milk is dried in a thin layer at a high temperature on a revolving drum and then reduced to powder or after

condensation it is sprayed in a fine stream under pressure into a hot air chamber where the solids drop to the bottom as a fine powder It is made from either whole milk or skim milk If it is made from the former government regulations require that it contain not less than 26 per cent of milk fat and not more than 5 per cent moisture If it is made from the latter the butter fat may again be added when it is reconstituted

Milk powders are used extensively in the baking confectionery and ice cream industries As an economical source of calcium phosphorus and good protein dry milk is believed to merit a much wider use in the family kitchen It can also be profitably used as a supplement to fresh whole milk The value of dry skim milk to the family on a low budget has been discussed in the section on the cost of food

## Cheese

*For centuries cheese has been a satisfactory medium for the preservation in palatable form of the nutritive elements of milk It furnishes many races with a large part of their protein In America the making of cheese has become a successful industry and the consumption of this food is increasing*

Cheese contains all the casein and some of the albumins and salts of the milk from which it comes if made from whole milk it also contains the fat Its flavor odor consistency and appearance depend on the method of manufacture and the nature of the organisms concerned in its ripening The following brief description of the methods of manufacture and the composition of various cheeses is taken largely from Sherman There are two main types the hard varieties such as American (Cheddar) Swiss (Emmentaler) Edam Parmesan and Roquefort and the soft varieties such as Brie Camembert Neufchatel Gorgonzola and Limburger

American or Cheddar cheese is the variety largely produced in this country Whole milk of good quality is used in its manufacture The several stages through which the curd must go are as follows ripening of the milk precipitation of the curd through the addition of rennet the removal *of the whey and the packing or cheddarizing of the curd* milling salting and pressing of the curd and then ripening for several weeks or months through storage at an appropriate temperature The predominant organisms in this process of ripening are *Streptococcus lactis* and those of the Lactobacillus group

Edam cheese from Holland and pineapple cheese made in this country are both hard rennet cheese from whole milk both are artificially colored Swiss or Emmentaler cheese belongs in the same class but it is made from skim milk Its characteristic flavor and the carbon dioxide gas which develops during ripening with the resulting holes are all due to the particular type of bacteria concerned

Roquefort is a hard rennet cheese made from the milk of the goat It acquires a marbled appearance through the development in it of Penicillium its chief ripening agent Parmesan is a hard cheese which is especially useful when grated cheese is desired it has excellent keeping qualities

Soft cream cheese, popular in this country, is made from soured cream or sweet cream thickened with rennet. It differs from other soft cheeses in having more fat and water and less protein. It is commonly sold in small tinfoil packages.

Camembert is a soft rennet cheese made from cow's milk. It has a thick rind, consisting in part of molds, and an interior of a soft, somewhat creamy consistency. Its characteristic odor and flavor are due to molds *(Oidium lactis)* and to the proteolytic ferments which digest the casein and thus incidentally give to the cheese a soft consistency. Brie is a soft cheese similar to Camembert. Neufchâtel is a soft rennet cheese made from cow's milk, whole or skimmed. Gorgonzola is also a soft rennet cheese made from whole cow's milk; it has a mottled appearance and a characteristic odor due to the development of Penicillium. Limburger cheese owes its odor and taste to the development of putrefactive bacteria.

In the making of cheese some of the nutritive principles of the milk are lost. For example, cystine and other indispensable amino acids undergo some destruction in the ripening of Limburger cheese. Rennet cheeses retain the calcium of the milk (and perhaps other minerals as well) better than cream cheese. It is said that Swiss cheese contains fourteen times as much calcium and Cheddar nine times as much as cottage cheese. The vitamin content of cheese, except as regards riboflavin, is said to be largely dependent upon the age of the cheese and the ripening process to which it has been subjected.

**Contamination.** The contamination of cheese with disease-producing organisms is a danger that is receiving increasing attention; a number of epidemics due to cheese-borne infections have been reported. Several states have enacted laws requiring that the milk used for making cheese be pasteurized or that the finished product be stored for a period of sixty days prior to sale. Public health authorities are urging, as a still better precaution, a ninety or a 120 day holding period.[10]

**Food Value.** Cheese is a highly nutritious, economical food. It is rich in protein, fat and mineral elements. The amount of protein and fat in a pound of good cheese equals that of a gallon of milk and appreciably exceeds that of the same weight of the best steak. The protein is of high quality; it consists largely of casein which in the ripening process has been partially digested. About 69 per cent of the nitrogen of ripened cheese (six months) is in soluble form. The fat of the cheese is easily assimilated and differs but little in character from that of milk; its amount depends largely on whether whole or skim milk was used in the making. It is a valuable article of diet. The composition of cheese is given in Table 144 in the Appendix.

For a more complete discussion of cheese, the reader is referred to the treatise on food products edited by Jacobs.[11]

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# 9

## *Meat, Fish and Eggs*

### MEAT

Meat is the edible portion of the animal. It includes the organs as well as the muscle meats, and the term properly applies to the food derived from poultry, game and fish as well as to that derived from the animals ordinarily slaughtered for the market.

Meat is eaten because of its richness in good protein. It contains approximately 20 per cent of protein, with a variable amount of fat and other substances and about 70 per cent of water. The muscle meats are consumed in vastly greater amounts than the organ meats, although the latter have certain points of superiority over the former. The chemical composition of the different cuts and of the organs will be found in Table 144 at the end of this book. For purposes of comparison the average composition of the muscle meats ordinarily eaten and of the organs is shown in Table 44.

The *muscle meats* consist of protoplasm, connective tissue, fat, extractives and small amounts of sugar and mineral salts. Protoplasm is about three fourths water and one fourth protein, thus protein is held both in solution and as an integral part of the cell structure. The proteins of meat furnish in liberal measure the amino acids necessary for the construction of tissue and therefore are of high biologic value. In this respect they are superior to vegetable proteins.

The amount of *connective tissue* is small, particularly in meat of younger animals and in the more desirable cuts.

The amount of *fat* depends largely on the nutritive state of the animal and therefore is variable. The manner in which it is deposited in the tissues varies with the kind of meat. In beef it is in distinct layers, which can be separated from the lean meat. A part of this fat is removed by the butcher and still another portion by the cook, so that when the food actually reaches the table it contains as a rule less fat than the ordinary accepted analyses indicate. In pork, however, the fat is deposited in minute amounts throughout the entire muscle, which explains the higher fat content of this meat.

Meat contains certain *extractives*. Chief among these is *creatine* which is present in lean meat to the extent of about 0.25 per cent. Purine bases are also present, these are much more abundant in the liver and other

organs than in muscle Glycogen also is found in small amounts Meat is distinctly acid forming

The studies of Elvehjem[1] have emphasized the value of the vitamins and minerals as well as the proteins in muscle meats Since meat is not eaten raw, the destructive influence of cooking must of course be con

**Table 44 Percentages of Lean, Visible Fat and Bone in the Retail Cuts**
(Hall and Emmett[2])

| Retail Loin Cuts | Lean | Fat | Bone | Total |
|---|---|---|---|---|
| Sirloin steak (butt end) | 70 46 | 23 32 | 5 67 | 99 45 |
| Sirloin steak (wedge bone) | 69 82 | 23 27 | 6 40 | 99 49 |
| Sirloin steak (round bone) | 65 71 | 28 17 | 5 37 | 99 25 |
| Sirloin steak (round bone) | 61 43 | 29 18 | 8 94 | 99 55 |
| Sirloin steak (double bone) | 59 01 | 26 55 | 13 84 | 99 40 |
| Porterhouse steak | 55 49 | 35 41 | 8 23 | 99 13 |
| Porterhouse steak | 54 83 | 34 33 | 9 52 | 98 68 |
| Porterhouse steak | 50 04 | 41 44 | 7 77 | 99 25 |
| Club steak | 55 38 | 36 35 | 7 89 | 99 82 |
| Club steak | 55 33 | 32 93 | 12 80 | 99 06 |
| Club steak | 54 10 | 33 81 | 11 19 | 99 10 |
| Trimmings (wholesale) | 9 79 | 90 21 | 0 | 100 00 |
| Entire loin | 58 53 | 31 75 | 8 89 | 99 17 |

| Retail Rib Cuts | Lean | Fat | Bone | Total |
|---|---|---|---|---|
| D | 49 44 | 37 74 | 12 41 | 99 59 |
| | 54 26 | 31 41 | 13 97 | 99 64 |
| | 56 00 | 27 81 | 15 79 | 99 60 |
| | 61 43 | 23 72 | 14 27 | 99 42 |
| Entire rib | 55 21 | 30 17 | 14 18 | 99 56 |

| Retail Round Cuts | Lean | Fat | Bone | Total |
|---|---|---|---|---|
| Rump roast | 48 62 | 31 13 | 19 81 | 99 57 |
| Round steak (first cut) | 74 16 | 13 57 | 11 25 | 98 99 |
| Round steak | 76 99 | 13 19 | 9 02 | 99 20 |
| Round steak | 84 47 | 9 71 | 5 13 | 99 31 |
| Round steak | 83 12 | 12 94 | 3 33 | 99 39 |
| Round steak | 81 84 | 14 36 | 2 64 | 98 84 |
| Knuckle soup bone | 19 00 | 21 78 | 58 36 | 99 14 |
| Pot roast | 85 43 | 13 38 | 0 87 | 99 68 |
| Shank soup bone | 40 13 | 11 37 | 47 62 | 99 12 |
| Shank soup bone | 66 72 | 12 35 | 20 19 | 99 46 |
| Shank soup bone (hock) | 8 08 | 10 36 | 80 86 | 99 30 |
| Entire round | 64 61 | 18 03 | 16 63 | 99 27 |

(From Hall S D and Emmett A D Univ of Ill Agric Exper Station Bull 158 1912 table 12)

**Table 44 Percentages of Lean Visible Fat and Bone in the Retail Cuts (Continued)**

| Retail Chuck Cuts | Lean | Fat | Bone | Total |
|---|---|---|---|---|
| Roast (fifth rib) | 64 07 | 20 78 | 14 65 | 99 50 |
| Chuck steak | 62 11 | 18 80 | 18 33 | 99.24 |
| Chuck steak | 66 26 | 22 29 | 10 94 | 99 49 |
| Chuck steak | 72 41 | 15 81 | 11 37 | 99 29 |
| Pot roast | 58 45 | 26 53 | 13 94 | 98 92 |
| Pot roast | 78 06 | 9 07 | 12 66 | 99 79 |
| Stew | 60 79 | 33 86 | 5 03 | 99 68 |
| Clod | 80 39 | 14 62 | 4 69 | 99 70 |
| Neck | 60 47 | 22 12 | 16 48 | 99 07 |
| Entire chuck | 69 47 | 18 63 | 11 26 | 99 36 |

| Retail Plate Cuts | Lean | Fat | Bone | Total |
|---|---|---|---|---|
| Brisket | 53 33 | 38 81 | 7 78 | 99 92 |
| Navel | 54 87 | 37 22 | 7 91 | 100 00 |
| Rib ends | 49 44 | 37 31 | 12 35 | 99 10 |
| Rib ends | 50 79 | 36 39 | 12 36 | 99 54 |
| Wholesale trimmings | 13 89 | 86 11 | 0 | 100 00 |
| Entire plate | 50 61 | 40 73 | 8 47 | 99 81 |

| Retail Flank Cuts | Lean | Fat | Bone | Total |
|---|---|---|---|---|
| Stew | 64 11 | 34 79 | 58 | 99 48 |
| Flank steak | 83 05 | 16 44 | 0 | 99 49 |
| *Trimmings (wholesale)* | 37 | 99 63 | 0 | 100 00 |
| Entire flank | 36 30 | 63 18 | 0 25 | 99 73 |

| *Retail Fore shank Cuts* | Lean | Fat | Bone | Total |
|---|---|---|---|---|
| Stew | 82 58 | 17 10 | 0 | 99 68 |
| Soup bone (knuckle) | 29 38 | 11 12 | 58 68 | 99 18 |
| Soup bone | 28 03 | 10 98 | 60 23 | 99 24 |
| Entire shank | 47 61 | 11 63 | 40 20 | 99 44 |

sidered Elvehjem found that about 10 to 15 per cent of the vitamin content is lost in frying and that approximately 40 to 50 per cent is lost in roasting He adds The results also show that meat carries its fair share of the vitamin burden and if meat is used in a diet which contains other ingredients which carry their fair share we will have a diet which will continue to promote optimum health The nutritive composition of meat is detailed in the Appendix Table 144

Most meat is tough and indigestible immediately after the a
killed, but after a few days the enzymatic process of "aging" sol
connective tissue and renders the meat tender. For this reason, l
other slaughter house products are kept in cold storage, sometir
long periods. If the meat is kept sufficiently cold, it improves fo
in flavor and eating qualities. Meat which has been frozen kee
better than that which has been stored at only 2° or 3° C.

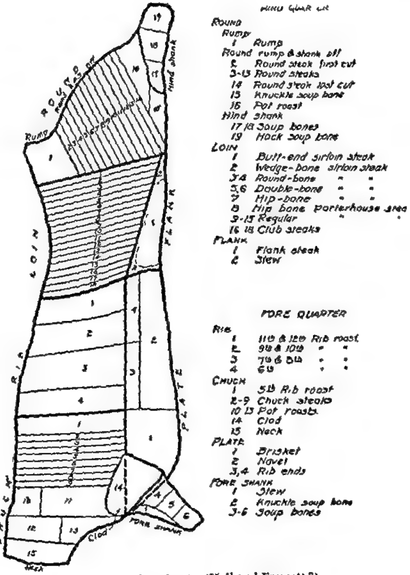


Fig 6 Retail cuts (Hall and Emmett [2])

The organs furnish more complete food than do the supporti
contractile tissues. They provide appreciable amounts of vitar
thiamine and riboflavin, with a small amount of vitamin C, a
quality of their proteins is high. McCollum and his associates[3] s

has the greatest nutritive value that liver is second in value and that muscle is third They regard the proteins of kidney, liver and milk as being most nutritional The great value of liver as a blood building food was discovered by Robscheit Robbins and Whipple [4] and this discovery was made use of by Minot and Murphy in the diet they devised for persons with pernicious anemia The superiority of the organs has seldom received adequate recognition

Kinds of Meat * *Beef* Beef is more commonly eaten in this country than any other meat Perhaps this is because the beef industry is more highly developed and the animals are fatter and better prepared for the market Certain it is that in flavor and eating qualities no other meat sold in America is superior to good beef No other meat can be eaten as regularly day in and day out without tiring the appetite

*Veal* Veal is the meat of the calf Since meat from young calves is tough and indigestible it is required by law that the calf be at least three weeks old when slaughtered The belief that veal is not as digestible as other forms of meat has no scientific basis

*Mutton and Lamb* Mutton and lamb are desirable forms of meat and in Europe are regarded as more delicate and more easily digested even than beef The flavor of good mutton is said to resemble that of venison The leg of the animal and chops taken from the ribs or elsewhere are the parts usually eaten

*Pork* Pork is characterized by its high fat content and by its richness in thiamine Indeed it is now recognized as an excellent source of this vitamin The fat is deposited between the individual fibers throughout the meat it is not in separate layers as in beef Therefore the fat must be eaten with the protein which renders pork less easily digested by some persons than other forms of meat Well smoked ham however is tender and by many is well borne Only about one tenth of the pork is eaten fresh the remainder being preserved by salting and in other ways

*Poultry and Game Birds* The meat of poultry and game birds does not differ in nutritive qualities from other meats The supply of amino acids and the vitamin and mineral contents are essentially the same

An effort has been made to distinguish between white and dark meats The former are of looser texture with more nuclei and they also contain less connective tissue and less fat There is no difference in the nutritive qualities of the two except that the former is richer in nicotinic acid The popular belief that the patient who must restrict his protein consumption can with impunity take white but not red meats is due to gross misconception

Game birds such as quail dove and wild duck are scarcely to be considered here since they are not sold in the market and form no appreciable part of the nation s food supply When obtainable they provide a welcome variation in the diet

Preservation of Meat The preservation of meat is undertaken in various ways by cold storage drying smoking and canning

*Cold storage* is the best method of preservation for all meat improves

* Dependable information can be obtained from the pamphlet Buying Guide to the Thriftier Cuts of Meat issued by the American Institute of Chicago

for a time when kept sufficiently cold Richardson and Scherubel [6] in their studies on frozen meats found that a thin layer of ice forms around the muscle fibers which then become distorted and shrunken they say that this layer presents an impenetrable barrier to bacteria They found that beef which had been kept frozen as long as 600 days was free from bacteria beyond a depth of 1 cm but that meat which had been kept merely cold at a temperature of 2° to 4° C at the end of thirty days showed the presence of bacteria Emphasis is placed on the difference in keeping qualities between meat which is actually frozen and that which is merely chilled

These investigators found that frozen meat quickly dried to a depth of a few millimeters but that after this it underwent no further appre ciable physical or chemical change The preservation of frozen meat over long periods interfered in no wise with its wholesomeness or its nutritive value The modern methods of quick freezing used extensively in the preservation of meat fish and poultry preserve excellently the retail cuts of meats and increase their tenderness

In the process of *canning* meat is first parboiled and after removal of the fat is preserved with some of the concentrated soup liquor in which it was boiled Salt sugar and other substances may be added to improve the flavor This is usually labeled canned beef If the meat is cured with salt and saltpeter before canning it is called canned corned beef The cheaper cuts of lean meat are usually used for this purpose In these processes the meat loses a large part of its fat and extractives but only about 1 per cent of its protein If properly canned it is nutri tious and wholesome

*Smoking* over a wood fire is a time honored process of preservation It not only enhances the keeping qualities of the meat but softens the fiber and gives a certain desirable flavor which is difficult to imitate The process is slow quicker methods are now in vogue but there is no good substitute for properly smoked ham

*Preservatives* such as saltpeter salt sugar and vinegar are sometimes used In addition to acting as a preservative the first named substance deepens the red color of the meat while the others add to its flavor

*Drying* of meat is sometimes done in dry climates The meat is pre served by being cut in strips and hung out to dry This is a slow process and the resulting product is not as good as other forms of preserved meats Dried lean meat mixed with fat is the pemmican used by arctic explorers

*Meat extracts* were originally believed to be highly nutritious but this is not true These products are mildly stimulating and pleasant to take but they are practically without food value Almost all the con tained nitrogen is in the form of extractives chiefly creatine and purine bases Such extracts were first prepared by Liebig and are frequently called Liebig s extracts

**Inspection of Meat** The inspection of all meat intended for interstate commerce or for export is carried out rigidly by the United States De partment of Agriculture The object is to prevent the sale of meat ob tained from diseased cattle or contaminated after slaughter The carcass

is easily infected; for instance, *Bacillus enteritidis* rapidly penetrates meat.[7] Contamination may come from the hands of workers who happen to be carriers or from the fecal material of apparently healthy animals; epidemics of food poisoning have been traced to meat infected with this organism.

The government's expert inspectors have access to every part of the slaughter house and examine the carcass of every animal. Diseased animals are immediately set aside and treated in such a way as to render them unfit for food. In order to reduce to a minimum the chance of contamination, the manner in which the meat is handled is rigidly controlled. The government also aids in the commerical grading of meats by setting up standards for classification. The sex, age and nutritive state of the animal determine the desirability of the meat, which accordingly is classed as prime, choice, good, medium or common.

**Place of Meat in the Dietary.** Meat takes a prominent place in the dietary because of its flavor, the stimulating influence of its extracts and the high biologic value of its proteins. As a good source of vitamins also, notably thiamine and riboflavin, it is receiving increasing recognition. To insure normal growth for the child and continued vigor and longevity for the adult, a sufficient amount of protein is essential.

The proteins of meat are surpassed in nutritive quality only by those of milk; they are equaled by the proteins of eggs. Milk and eggs have a distinct advantage over meat in respect to their vitamin and mineral content. To replace meat entirely with milk and eggs is compatible with good nutrition. Except among pastoral peoples, however, this rarely is feasible. Such a diet would lack the stimulating influence upon appetite and digestion which comes from meat; also, the adult could not be depended on to drink enough milk fully to supply the requisite protein.

The superiority in food value of the organs, particularly the kidney and liver, as regards vitamin content, blood-building properties and the high quality of their proteins, should again be emphasized. They are not ordinarily accorded the place in the dietary to which they are entitled.

Some persons have scruples, usually unwarranted, against the eating of meat and endeavor to secure their proteins largely from vegetables. The proteins of grains and vegetables, being deficient in certain amino acids, are of low biologic value and cannot satisfactorily serve as the sole sources of protein. If the adherents to such a diet would supplement the vegetable proteins by taking a sufficient amount of milk, the diet would be right; otherwise it is faulty. The objections to a meat diet offered by vegetarians do not bear scrutiny. History does not indicate that the eating of meat has the debasing influence, physical or moral, feared by them. The most vigorous, intellectual and highly civilized peoples the world has known have eaten meat. One writer who contradicts the statement concerning the debasing influence of meat calls attention to the fact that Moses, David, Solomon and Jesus ate meat.

It must be admitted, however, that in addition to its advantages, meat presents certain pronounced deficiencies. It is richer in purine bodies than other foods and therefore if eaten in large amounts may lead to

an increased production of uric acid It is also acid forming in its tendency which might under certain circumstances be a disadvantage

Meat is expensive and therefore is not an economical source of protein Before World War I Americans consumed twice as much meat per capita as continental Europeans and one and a half times as much as the English Sherman thinks that Americans with advantage could reduce the national meat ration to about half its present amount In the average family budget this would mean that the allowance for meat would be one sixth of the total amount spent for food Such a reduction in the nation s consumption of meat would perhaps be advantageous if there were a proportionate increase in the consumption of milk and milk products There seems to be a definite tendency toward such a readjustment

**Summary** The excessive consumption of meat restricts the eating of other necessary foods and for other reasons as well is probably inadvisable To insure however an adequate intake of protein of good quality there should be included in the dietary approximately one serving of meat (or fish) each day The organs particularly liver and kidney can with advantage occasionally be substituted for muscle meats

## FISH

Fish does not differ materially from other forms of meat It contains more collagen and thus yields more gelatin than does meat and has a smaller amount of extractives and less hemoglobin Its proteins however are fully equal in nutritive value to those of other animals It usually contains less fat and more water The fat content largely determines the digestibility of the particular fish those with the smallest amount of fat being more easily digested The nutritive composition of fish is given in Table 144 in the Appendix

The kind of stream or other body of water from which fish comes influences somewhat the flavor but not necessarily the nutritive value (nor salt content) There is no difference in the food qualities of fresh and salt water fish preferences for the one or the other being purely individual As a rule fish that come from clear cold waters are more highly prized sandy rocky streams yield a more desirable catch than those with mud bottoms Fish that prey on smaller fish and Crustacea are to be preferred to those which subsist on sewage and similar material

**Preservation** Fish spoil quickly largely because of bacterial invasion but enzymes also cause an unpleasant flavor which destroys palatability For preservation or transportation to market fish should be frozen dried salted or canned A temperature of 32° F will retard bacterial development but is not sufficiently low to prevent ferment action to insure good preservation fish should be kept at 25° to 30° F Fish frozen by the older method sometimes undergo desiccation loss of flavor and other changes but this is not true of those frozen by the modern methods of quick freezing These newer methods involve innovations in transportation and handling for fish must be delivered to the consumer in the frozen state

**Table 45 Composition of the Edible Portion of Mollusks Crustaceans etc.**
**(Bureau of Fisheries[5])**

| Name | Total Solids | Fat | Protein (N × 6.25) | Ash (Inorganic Matter) | Carbohydrates | Fuel Value per Pound |
|---|---|---|---|---|---|---|
| Fresh | Per cent | Per cent | Per cent | Per cent | Per cent | Calories |
| Abalone | 27.2 | 0.1 | 21.7 | 1.3 | 3.3 | 469 |
| Long clams | 20.6 | 1.7 | 13.6 | 2.5 | 2.8 | 377 |
| Round clams | 19.2 | 1.1 | 10.6 | 2.3 | 5.2 | 340 |
| Crab (eastern hard) | 22.9 | 2.0 | 16.6 | 3.3 | 1.2 | 415 |
| Crawfish (eastern) | 18.8 | 0.5 | 16.0 | 1.3 | 1.0 | 337 |
| Frog s legs | 16.3 | 0.2 | 15.5 | 1.0 | | 315 |
| Lobster | 20.8 | 1.8 | 16.4 | 2.2 | 0.4 | 388 |
| Mussels | 15.8 | 1.1 | 8.7 | 1.9 | 4.1 | 283 |
| Oysters (eastern) | 13.1 | 1.2 | 6.2 | 2.0 | 3.7 | 235 |
| Scallops | 19.7 | 0.1 | 14.8 | 1.4 | 3.4 | 343 |
| Shrimps | 22.7 | 0.4 | 19.3 | 1.5 | 1.7 | 407 |
| Terrapin | 25.5 | 3.5 | 21.2 | 1.0 | | 542 |
| Turtle (green) | 20.2 | 0.5 | 19.8 | 1.2 | | 390 |
| Boiled | | | | | | |
| Dungeness crab (Pudget Sound) | 22.8 | 0.3 | 21.0 | 2.1 | 0.3 | 409 |
| Spiny lobster (southern California) | 27.4 | 0.3 | 24.6 | 1.7 | 0.1 | 472 |
| Shrimp (Alaska) | 30.9 | 1.0 | 24.6 | 5.3 | | 500 |
| Preserved | | | | | | |
| Abalone (canned) | 26.8 | 0.1 | 21.7 | 1.3 | 3.7 | 478 |
| Abalone (dried) | 60.3 | 0.5 | 36.0 | 2.9 | 20.9 | 1079 |
| Long clams (canned) | 15.5 | 1.3 | 9.0 | 2.3 | 2.9 | 276 |
| Round clams (canned) | 17.1 | 0.8 | 10.5 | 1.0 | 3.0 | 285 |
| Crab (eastern hard canned) | 20.0 | 1.5 | 15.8 | 1.9 | 0.8 | 372 |
| Lobster (canned) | 22.2 | 1.1 | 18.1 | 2.5 | 0.5 | 392 |
| Oysters (canned) | 16.6 | 2.4 | 8.8 | 1.5 | 3.9 | 337 |
| Shrimp (canned dry pack) | 32.3 | 0.8 | 25.5 | 2.9 | * | 508 |
| Shrimp (canned wet pack) | 24.3 | 0.5 | 20.0 | 1.9 | * | 393 |
| Dried shrimp | 87.5 | 5.0 | 71.4 | 6.8 | * | 1540 |

* Carbohydrates present but undetermined

The *drying* of fish in Norway is done in the open air but in America the process of curing is more complex salt is used in large amounts both as a preservative and as a dehydrating agent *In the drying* of salt cod at Gloucester Massachusetts the fish are salted in the boat as soon as caught They are placed in a salt butt at the factory after which further water is removed by pressure and by drying in the air

The *canning* of fish has become a great industry Many different kinds of canned fish are found on the market the largest amount being of sardines and salmon The sardines which come from France packed in olive oil are superior in flavor but the American product is more economical and is just as good a food The American sardines are salted cooked and packed in cottonseed oil In the canning of *salmon* the fish are *cut into pieces* placed in cans and then salted and heated The

heating completely sterilizes the contents of the cans The salmon canning industry is rigidly controlled by the United States government and a clean high grade product is assured

**Shellfish** Oysters and other shellfish are excellent food and are eaten extensively the oyster industry has become a large one Oysters resemble in composition other forms of fish or meat except that they contain a larger amount of carbohydrate After removal from salt water oysters are usually fattened by being placed for forty eight hours in fresh or brackish water They become larger and improve in flavor during this process but it is doubtful whether there is an actual increase in the contained nutritive material

The studies of Sherman on the ash of the oyster show that in calcium content it ranks above meat and below milk It contains the other mineral elements in fair amounts It is acid forming

Clams crabs lobsters and shrimp are similar to oysters in eating qualities and also in the rapidity with which they deteriorate Many persons exhibit idiosyncrasies toward them this is sometimes due to decomposition products in shellfish which are not thoroughly fresh

The contamination of oysters with disease producing bacteria is a real menace numerous epidemics of typhoid fever have been traced to this source If the water in which the oyster grows is contaminated with sewage germs are taken into the shell and the oyster becomes infected The fresh water in which the oyster is fattened is a prolific source of such contamination It has been stated that cooking does not remove this danger since shellfish are seldom cooked sufficiently long to sterilize them The oyster industry is subjected to ever increasing governmental vigilance which is gradually making danger of contamination more remote

**Digestibility** The digestibility of fish and shellfish meaning the completeness with which the contained proteins and fats are utilized is about the same as that of beef and other meats In ease of digestion and rapidity with which they leave the stomach oysters and lean fish rank with poultry and lean beef fat fish lobsters and crabs rank with other fat meats such as goose and pork

**Nutritive Value** The nutritive value of the protein and fat of fish is the same as that of other meats The richness of many fish oils in vitamins A and D however gives to this food a certain distinction and justifies for it a specific place in the dietary Vitamin A is found in small amounts in the flesh of lean fish and in much larger amounts in the liver Canned salmon is said to provide fair amounts of vitamins A and D Shellfish while varying somewhat in this respect are comparatively rich in vitamins The large supply of iodine carried by shellfish is also of value In the case of shellfish such as oysters and clams the entire animal (except the shell) including the organs of active metabolism is eaten and thus vitamins are secured which are not found in muscle meats Fish and shellfish are used as supplementary foods they can however adequately serve as the sole source of protein as has been demonstrated abundantly by other peoples They always form a profitable addition to the diet

## EGGS

The egg furnishes all the nutritive substances necessary for the complete development of the young chick, from which one must conclude that it contains a wide range of such substances. The average composition of the edible portion of eggs from different fowls is given in table 46. The discussion which follows will concern hen's eggs only, since the other varieties are seldom used.

The average egg weighs from 50 to 60 gm., of which about 12 per cent is represented by the shell. The edible portion is about 75 per cent water, 13 per cent protein and 12 per cent fat; or, more roughly still, three-fourths water, one-eighth fat and one-eighth protein. By weight, the edible portion is about one-third yolk and two-thirds white. The food of the fowl determines to a slight extent the composition of the egg, particularly as to its richness in vitamins and minerals, and the character of its fats. The yellow color of the yolk is due to a carotene-like pigment called lutein. Table 47 gives the percentage compositions of the white and the yolk of the egg.

The *proteins* of the egg are of the highest quality. There are two chief proteins, the ovalbumin of the white and the ovovitellin of the yolk. These two differ in structure and in amino acid content.

The *fat* of the egg, virtually all of which is contained in the yolk, is in a finely emulsified form. A part exists as phosphorized fats, of which lecithin is an example. A salient feature of egg fat, like that of milk, is the ease with which it is assimilated. Sherman cites an experiment by Volhard which indicated that 78 per cent of the fat of the egg can be digested in the stomach.

*Vitamins A, thiamine, riboflavin,* and *D* are present in eggs. The yolk is rich in vitamin A and riboflavin. It also contains an appreciable although not large amount of thiamine. It evidently contains a liberal amount of vitamin D, for Hess[10] showed that it has marked antirachitic properties. Egg yolk is much richer in these substances even than milk.

The *mineral elements* of the egg are sufficient for the development of the chick and therefore should be suitable for the human body. Calcium, phosphorus and iron are found chiefly in the yolk. The phosphorus is in large part in the form of phosphoproteins and phosphorized fats and in combination with protein. Iron is present in appreciable amounts, combined largely with protein. Eggs also contain a large amount of sulfur, which, on oxidation, yields sulfuric acid; this places eggs in the class of acid-forming foods.

**Digestibility.** The digestibility of the egg is good. In this respect the fat equals that of milk, being superior to most other forms of fat; the proteins also are easily and almost completely (approximately 98 per cent) utilized. The extent to which cooking influences the digestibility of the egg has been the subject of much investigation. Rose and MacLeod, from their studies on human subjects, concluded that the whites of eggs are well utilized whether taken in their natural raw state, beaten or cooked. They found that the coefficient of digestibility increases slightly in the order named: 80 per cent for plain raw whites

Table 46 Average Composition of Eggs (Langworthy)

| Description | Water (Per centage) | Protein (Per centage) | Fat (Per centage) | Ash (Per-centage) | Fuel Value per Pound (Calories) |
|---|---|---|---|---|---|
| Hen | | | | | |
| Whole egg, edible portion | 73 7 | 13 4 | 10 5 | 1 0 | 672 |
| White | 86 2 | 12 3 | 0 2 | 0 6 | 231 |
| Yolk | 49 5 | 15 7 | 33 3 | 1 1 | 1643 |
| Duck | | | | | |
| Whole egg edible portion | 70 5 | 13 3 | 14 5 | 1 0 | 835 |
| White | 87 0 | 11 1 | 0 03 | 0 8 | 203 |
| Yolk | 45 8 | 16 8 | 36 2 | 1 2 | 1683 |
| Goose | | | | | |
| Whole egg edible portion | 69 5 | 13 8 | 14 4 | 1 0 | 829 |
| White | 86 3 | 11 6 | 0 02 | 0 8 | 211 |
| Yolk | 44 1 | 17 3 | 36 2 | 1 3 | 1793 |
| Turkey | | | | | |
| Whole egg, edible portion | 73 7 | 13 4 | 11 2 | 0 9 | 700 |
| White | 86 7 | 11 5 | 0 03 | 0 8 | 210 |
| Yolk | 48 3 | 17 4 | 32 9 | 1 2 | 1660 |
| Guinea fowl | | | | | |
| Whole egg, edible portion | 72 8 | 13 5 | 12 0 | 0 9 | 735 |
| White | 86 6 | 11 6 | 0 03 | 0 8 | 212 |
| Yolk | 49 7 | 16 7 | 31 8 | 1 2 | 1598 |
| Plover | | | | | |
| Whole egg edible portion | 74 4 | 10 7 | 11 7 | 1 0 | 662 |
| Fresh water turtle eggs | 65 0 | 18 1 | 11 1 | 2 9 | 772 |
| Sea turtle eggs | 76 4 | 18 8 | 9 8 | 0 4 | 742 |
| Salted duck eggs | 68 0 | 12 0 | 9 2 | 4 0 | 594 |

Table 47 Comparison of White and Yolk of Egg

| Constituent | White | Yolk |
|---|---|---|
| Water per cent | 86 2 | 49.5 |
| Protein per cent | 12 3 | 15 7 |
| Fat per cent | 0 2 | 33 3 |
| Ash per cent | 0 6 | 1 1 |
| Calcium per cent | 0 01 | 0 14 |
| Magnesium per cent | 0 01 | 0 01 |
| Potassium per cent | 0 16 | 0 11 |
| Sodium per cent | 0 16 | 0 07 |
| Phosphorus per cent | 0 01 | 0.59 |
| Chlorine per cent | 0 15 | 0 1 |
| Iron per cent | 0 0001 | 0 0086 |
| Sulfur per cent | 0 196 | 0 157 |
| Weight per average egg ounces | 1 2 | 0 6 |
| Weight per average egg grams | 33 | 17 |
| Fuel value per average egg calories | 17 | 60 |

The occasional small discrepancies between the data for the entire egg and the sum of the data for white and yolk are due to the fact that the two sets of analyses did not cover exactly the same samples

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and 86 per cent for cooked whites with a rate between these two for beaten egg Hawk and his associates[12] found that while the method of cooking eggs influences the rate of digestion it does not affect their total utilization They noted that hard boiled and soft boiled eggs call forth about the same degree of gastric response but that the former are a little slower in leaving the stomach, scrambled eggs are still slower Properly fried eggs are handled by the stomach as easily as scrambled or boiled eggs It was found that eggs stimulate the stomach a little less and leave it a little sooner than meat

*Food Value of Eggs* Their food value is high True the egg contains no carbohydrate (or a small amount in the form of glycogen) but its proteins are of the best quality, it is rich in easily assimilable fats and it is a valuable source of vitamins and mineral elements Experiment has shown that as a suitable food for the growing animal it ranks next to milk For this reason and also because of its richness in iron it serves as an excellent adjunct to milk in the diet of the child and of the adult who is recuperating from illness The yolk is much more nutritious than the white It carries the vitamins and a large part of the mineral elements and gram for gram furnishes about seven times as much energy Although eggs vary considerably in size it is customary to estimate 6 gm of protein and 6 gm of fat, or approximately 75 Calories per egg

**Freshness of Eggs, and Their Preservation** Eggs like milk require care in handling so that they will not deteriorate The freshly laid egg has characteristics which can be recognized by a transmitted light a process known as candling These characteristics have been stated as follows[13]

Air space Not enlarged less than [illegible] inch in diameter
White Firm and clear
Yolk Dimly seen through the white as a shadowy object indistinct in outline The *chick spot is not visible*
Distinguishing characteristics No shrinkage and general firm condition of white and yolk The yolk of such an egg is stiff and well rounded the white is not watery and it whips well

The egg which is not fresh shows a larger air space the white is thin and clear and the yolk has a more definite outline and may occasionally show mottled areas

The quality of freshness of an egg is not solely dependent on age Eggs which are laid in clean nests gathered promptly handled carefully and kept cold remain fresh much longer than other eggs Delay in marketing and poor handling including storage at improper temperatures are said to cause the loss of about 8 per cent of market eggs and the unnecessary deterioration of a considerable part of the remainder Eggs may be kept fresh in the home for several weeks by immersion in a solution of water glass and preservation in a cool place This solution is made by diluting ten times with water the commercial concentrated solution of sodium silicate Only clean eggs of known freshness should be used

*Eggs are satisfactorily preserved* in large numbers and for long periods in cold storage at a temperature just above their freezing point

from 29° to 32° F Formerly, in order to prevent the development of molds, it was considered necessary to keep the air of the storage space dry with certain detrimental effects to the eggs but it has been found that a good circulation of air, even though humid, will serve the same purpose During storage the air space in the egg becomes larger, the yolk absorbs water from the white and becomes larger, and the white tends to adhere to the shell membrane and to precipitate minute crystals These changes, even the breaking of the yolk which some times occurs, do not interfere with the edibility of the egg The preju dice against cold storage eggs is not entirely justified, clean eggs kept a long time in cold storage are thoroughly edible and are much preferable to so called fresh eggs which have been poorly handled Fresh eggs, even 'yard eggs' are often much older than the consumer thinks

The edible portions of the egg may be removed from the shell mixed and preserved in the frozen state Second grade eggs and worse are often used for this purpose hence frozen eggs as a rule contain large numbers of bacteria, particularly *Bacillus coli* If, on the other hand, the eggs so preserved are originally of good quality and if the processes of candling breaking and freezing are properly carried out, the resulting product should be good

An extensive treatment of these food products will be found in Jacob s[11] treatise

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10 He
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# 10

## Other Foods

### GRAINS

Grains furnish the bulk of the world s food supply The *economy of production*, the richness of grain in carbohydrate and protein the facility with which *it may be stored and transported* and the ease with which it is prepared for the table all combine to make it our staple food No other food furnishes an abundance of carbohydrate and protein so cheaply It has been estimated that the average day s labor of one man on a wheat farm with modern implements produces enough food to *meet the requirements of one person for a year*[1]

However, *in the form in which it reaches the market, grain is by no means a perfect food* The proteins are of relatively low biologic value and the milled product is lacking in both mineral and vitamin content These deficiencies can be compensated for by the addition of milk

*In America wheat is the grain largely used rye and barley come next* in order of importance, and then maize (Indian corn) and oats Rice however, is consumed in such enormous amounts in many countries that taking the world as a whole, it must be regarded as the most important grain

*Wheat The wheat kernel consists in large part* (82 per cent) of endosperm which is made up of starch cells held in a fine reticulum of protein Each cell contains innumerable starch granules of varying size The endosperm is poor in mineral salts and does not contain vitamins Surrounding it is the aleuron layer, which is rich in protein At one end of the kernel is the germ which constitutes about 5 per cent of the whole it is rich in proteins of excellent quality *contains* the vitamins of the B complex and vitamins *A and E and has* an abundance of mineral elements It also contains an oil Surrounding the whole are several layers of bran, this is richer in ash than any *other* part of the kernel The bran contains a considerable amount of nondigestible roughage

The *proteins of the wheat are chiefly* gliadin and glutenin together known as gluten They are of low biologic value One of the most important properties of these proteins is their *glutinous quality* which is essential to good bread making since without it an elastic dough and bread of the proper consistency cannot be obtained

In the process of milling, the kernel is broken between successive rollers and goes through the gradual reduction process Sieves and other separating devices are placed between the several sets of rollers, and by means of these, fractions of varying composition are obtained The white flour of the endosperm, consisting almost solely of fine starch granules with little gluten, comes through first The so called middlings, which come later, have a yellowish tint and contain more gluten A mixture of these fractions in proper proportions constitutes the high grade patent flour of commerce This flour should have a slightly granular feel, but should not be coarse It is of lighter color than the lower grade flours Finely milled flour is greatly superior in keeping qualities to the whole grain In the milling of high grade flours all the germ and almost all the bran are discarded Because these discarded fractions contain all the vitamins and much mineral matter, the milling is sometimes modified, and varying amounts of these portions are retained These flours have been given distinctive names, such as graham and whole wheat

*Graham flour* contains the entire wheat kernel finely ground Because of the large amount of bran thus retained it has valuable laxative properties but for the same reason it is less completely digested High extraction flours have undergone a certain amount of reduction which has removed a large part of the bran, but the germ with its protein, oil, vitamins and minerals is retained Such high extraction flour is acceptable to most persons and its consumption is not associated with any gastrointestinal discomfort The economy of utilization of higher extraction flour is indicated by the following too-little known quotation from the report on the Digestibility of Bread by the Food (War) Committee of the Royal Society [2]

> That by increasing the extraction of wheat in milling from 80 to 90 per cent
>
> 1 A gain of energy available for man of 286 650 calories per metric ton of wheat milled would be obtained
>
> 2 A gain of protein available for man of 34 lbs on each ton of wheat milled would be secured

Whole wheat bread has a lower digestibility than does 90 per cent extraction flour[3]—a property attributable to its high content of fiber Negative calcium balances[3] which are observed on a diet of whole wheat bread alone can be prevented by fortification with calcium salts The need for such fortification is indicated by the reported association between an increase in rickets in Dublin[4] and the consumption of 100 per cent whole wheat flour It seems probable that a 90 per cent or so extraction flour has certain advantages over the whole meal flour These relationships and their implications for bread and flour policies are the subject of many discussions some of polemical nature Two sound discussions may be recommended [5, 6]

*Enriched flour* was devised by the Food and Nutrition Board of the National Research Council and subsequently approved by the Council on Foods and Nutrition of the American Medical Association [7] In the making of this flour three of the important essentials lost in the milling are restored in amounts which approximate those found in the flour

made by the old stone mills, that is, to the extent of about 85 *per cent* of the amounts found in the untreated grain To conform to standards fixed by the U S Food and Drug Administration,[8] enriched flour must contain vitamins and minerals per pound as follows

| | Minimum | Maximum |
|---|---|---|
| Thiamine | 2 0 mg | 2.5 mg |
| Riboflavin | 1.2 mg | 1.5 mg |
| Niacin | 16 0 mg | 20 0 mg. |
| Iron | 13 0 mg | 16 5 mg |
| Vitamin D optional | 250 units | 1000 units |
| Calcium optional | 500 mg | 625 mg |

Bread forms a large part of the American dietary Since lack of the substances missing in ordinary white flour is a potent cause of nutritive failure, it is believed that the general use of bread made from enriched flour materially elevates nutritive standards in this country

Table 48 Vitamin and Mineral Content of Flours

| | Whole Wheat Flour* (Mg /Lb ) | White Flour* (Mg /Lb ) | Enriched Flour† (Mg /Lb) |
|---|---|---|---|
| Thiamine | 2.53 | 0.35 | 2 0 |
| Riboflavin | 0.56 | 0 15 | 1.2 |
| Nicotinic acid | 25 3 | 3.50 | 16 0 |
| Iron | 17.3 | 3 00 | 13 0 |
| Pantothenic acid | 6 03 | 2.59 | |
| Pyridoxine | 2 09 | 0 99 | |

* Maynard [9]
† Minimal enrichment levels

**Rice** Rice, because of its great consumption in oriental countries is more largely used than any other cereal for half the human race it forms the chief article of diet The grain can be obtained in the market in three forms (*a*) unhulled, with the husk still adhering to the kernel, (*b*) cured, without the husk, but retaining the bran and (*c*) polished the husk, germ and bran all having been removed Polished (or white) rice is the form ordinarily eaten in this country, although brown rice is increasing in popularity because of its greater nutritive value and better flavor

Table 49 Analysis of Rice

| | Unhulled Rice | Cured Rice | Polished Rice |
|---|---|---|---|
| Weight of 100 kernels grams | 2 929 | 2 466 | 2 132 |
| Moisture per cent | 10 28 | 11 88 | 12 34 |
| Protein per cent | 7 95 | 8 02 | 7 18 |
| Fat per cent | 1 65 | 1 96 | 0 26 |
| Fiber per cent | 10 42 | 0 93 | 0 40 |
| Carbohydrates other than fiber per cent | 65 60 | 76 05 | 79 36 |
| Ash per cent | 4 09 | 1 15 | 0 46 |

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The decrease in B vitamins and iron during milling is illustrated by the following data for those nutrients in a popular brand of rice as the rice is milled [10]

| Type of Rice | Weight of 250 Grains (Gm) | Ash (%) | Ether Extract (%) | Thiamine (Mcg /Gm) | Riboflavin (Mcg /Gm) | Niacin (Mcg /Gm) | Iron (Mcg /Gm) |
|---|---|---|---|---|---|---|---|
| Rough | 5 48 | 6 79 | 1 78 | 2 64 | 1 07 | 45 00 | 31 01 |
| Brown | 4 45 | 1 38 | 2 08 | 3 36 | 0 90 | 43 00 | 17 14 |
| Undermilled | 4 21 | 0 79 | 0 62 | 1 27 | 0 56 | 35 00 | 9 30 |
| Head | 4 16 | 0 70 | 0 44 | 1 00 | 0 46 | 22 50 | 7 90 |

Rice is polished to enhance its keeping qualities, because the oil of the germ quickly becomes rancid and because insects quickly attack the whole but not the polished grain The polishing process, however, like the milling of flour, removes valuable constituents, notably vitamins and mineral elements Polished rice is markedly deficient in respect to the quality of its proteins and the quantity of its minerals and vitamins The discovery that a diet which consists solely of polished rice will produce beriberi gave an early incentive to the study of vitamins Polished rice is practically devoid of all vitamins but the disease in question is due specifically to the failure of thiamine The amount of phosphorus retained will give a fair index of the extent to which the polishing has removed both vitamins and ash

A practical method for the artificial improvement of white rice with thiamine has been devised [10] Application of this method has been shown to decrease the incidence of beriberi in Bataan [11] Other regions in which endemic beriberi presents a problem may find this method of combating the disease to be advantageous

Rye Rye is similar to wheat in composition and bread making qualities, but the bread is much darker That which is made from the whole grain, because of its greater cellulose content, is not so digestible as white bread or as that made of finely milled rye Rye bread is extensively eaten in northern Europe

Barley Barley is similar to wheat and rye in its nutritive properties and contains an additional protein called hordein "Pearl barley," which is the form in which this grain is largely eaten, is the milled product from which the germ and most of the bran have been removed It is of value chiefly as an addition to soup In finely powdered forms, known as "patent barley," it is also used for the preparation of infant foods, barley water is a frequent diluent for milk

Maize Maize, or Indian corn, is an excellent food for man Its popularity as a *foodstuff is largely due to the great caloric yield* of the crop It is widely held that maize was introduced into Europe from America In a scholarly discussion of the question Finan[12] has raised the question whether it arrived in Europe before the days of Columbus At any rate the crop is now a widespread staple article of the diet The composition of corn is similar to that of the other grains except that (like oats)

it has a larger fat content. It has about the same thiamine content as wheat, but only about one fourth as much nicotinic acid. It is a good source of minerals, but since both minerals and vitamins are largely lost in the milling it had best be regarded simply as an energy-yielding food. The yellow varieties, often regarded in the South as "animal food" and, hence, unacceptable foods, have considerable vitamin A activity and are nutritionally superior to the white corns.

There are several grades of corn, each best suited to certain purposes. Field corn, which is permitted to dry before being harvested, is used for corn meal, hominy and corn starch. Sweet corn is gathered while still green and is eaten as a vegetable.

Corn meal is used for making corn bread and for puddings; it will not undergo the leavening which wheat flour admits and therefore does not make the same type of bread. Well-made corn bread, however, is nutritious, easily digested and delicious. The "water ground" meal of our fathers was the best, because only the coarser particles were removed and all the germ, with a portion of the bran, was retained; it is seldom seen today, but the "old process," as it is now called, makes a similar meal. Further milling, with removal of all the bran and germ, makes a fine meal which contains less oil and therefore keeps better, but it is of distinctly lower nutritive value and to those who are fond of corn bread is not so palatable.

Corn starch is made by a process of grinding and sedimentation which permits the complete separation of the germ and the bran. The starch of the endosperm is thus first separated and then further purified.

Pellagra is usually encountered wherever corn constitutes a primary source of Calories in the diet. This fact has led to considerable support for the addition of niacin to corn meal. Indeed, the Food and Drug Administration has established the following standards for enriched corn meal:[8]

| | *Minimum* | Maximum |
|---|---|---|
| Thiamine | 2.0 mg./lb. | 3.0 mg /lb. |
| *Riboflavin* | 1.2 mg./lb. | 1.8 mg /lb. |
| Niacin | 16.0 mg./lb. | 24.0 mg /lb |
| Iron | 13.0 mg /lb. | 26.0 mg /lb. |
| Vitamin D (optional) | 250 units/lb. | 1000 units/lb. |
| Calcium (optional) | 500 mg./lb. | 750 mg /lb. |

**Oats.** Oats are widely used as a breakfast food. In the preparation of rolled oats or oatmeal, only the chaffy husk is removed; the germ and bran are largely retained. This gives to oat products a richer content of proteins, fat, vitamins and ash than is ordinarily obtained from cereals.

**Buckwheat.** Buckwheat is used largely in the making of pancakes. In the milling a certain amount of the bran is retained. Well-made buckwheat cakes eaten with syrup form a delightful breakfast dish, but buckwheat preparations are not so digestible as similar dishes made from wheat flour or corn meal.

**Nutritive Value of Grains.** Grains are closely allied in nutritive value. The differences depend largely on the structure of the proteins and

the manner in which the grain is prepared Roughly the food value of an ounce (30 gm) of milled grain approximates 100 Calories The value of the grains as they are prepared for human consumption is determined by (*a*) the carbohydrate content (*b*) the nature of the proteins and their amount (*c*) the vitamins (*d*) the mineral elements and (*e*) certain other factors such as roughage and oil

Table 50 gives the chemical composition of grains as determined by the United States Department of Agriculture [13]

**Table 50 Average Composition of Some Commoner Grains**

| Kind of Food | Constituents of Edible Portion | | | | | | |
|---|---|---|---|---|---|---|---|
| | Water | Protein | Fat | Ash | Carbohydrate | Fiber | Fuel Value per 100 Grams |
| | Per cent | Per cent | Per cent | Per cent | Per cent | Per cent | Calories |
| Barley pearled pot or Scotch | 10 8 | 8 7 | 1 0 | 1 2 | 78 3 | 0 8 | 357 |
| Buckwheat flour | | | | | | | |
| Dark and very dark | 12 0 | 12 4 | 2 4 | 1 6 | 71 6 | 1 0 | 358 |
| Light and very light | 12 0 | 6 3 | 1 1 | 0 9 | 79 7 | 0 4 | 354 |
| Pancake prepared self rising | 10 9 | 11 3 | 2 2 | 5 6 | 70 0 | 1 3 | 345 |
| Corn meal | | | | | | | |
| Whole ground (white or yellow) | 12 0 | 9 1 | 3 7 | 1 3 | 73 9 | 2 0 | 365 |
| D | 12 0 | 7 5 | 1 1 | 0 6 | 78 8 | 0 8 | 355 |
| | 12 0 | 8 3 | 1 2 | 0 5 | 78 0 | 0 7 | 356 |
| | 84 8 | 2 3 | 1 2 | 0 7 | 11 0 | 0 2 | 64 |
| Brown | 12 0 | 7 5 | 1 7 | 1 1 | 77 7 | 0 6 | 356 |
| White | 12 3 | 7 6 | 0 3 | 0 4 | 79 4 | 0 2 | 351 |
| White *boiled* | 74 4 | 2 2 | 0 1 | 0 1 | 23 2 | 0 1 | 102 |
| Puffed | 9 3 | 6 7 | 0 3 | 0 4 | 83 3 | 0 3 | 363 |
| Flakes | 8 3 | 7 7 | 0 5 | 1 5 | 82 0 | 0 7 | 363 |
| Polishings | 9 3 | 11 6 | 10 1 | 5 0 | 64 0 | 2 2 | 393 |
| Rye flour medium dark | 11 0 | 11 0 | 1 2 | 1 0 | 75 8 | 1 5 | 358 |
| Wheat flours | | | | | | | |
| Graham all types | 11 0 | 13 0 | 2 0 | 1 6 | 72 4 | 1 8 | 360 |
| Patent all purpose | 12 0 | 10 8 | 0 9 | 0 4 | 75 9 | 0 3 | 355 |

Taken by permission from the table on Proximate Composition of American Food Materials by Charlotte Chatfield and Georgian Adams[13] of the United States Department of Agriculture

The carbohydrate of grain is its chief nutritive constituent and man s carbohydrate food the world over comes largely from this source The carbohydrate contents of all grains are practically the same

The proteins vary according to the nature of the grain The amount and quality of the proteins in grain products depend somewhat on the extent to which the kernel has been milled Many of the cereal proteins

lack some essential amino acid, hence they are of low biologic value For instance, zein, the chief protein of corn, is lacking in tryptophane[14] and along with gliadin and hordein, contains insufficient amounts of lysine It should be said, however, that each grain contains other proteins as well and that some have a tendency to make up for the deficiency of others Wheat, rye, barley and oats are of about equal value in respect to their proteins For a fuller discussion of this subject see the reports of Osborne and Mendel[15] *Milk proteins supplement the proteins of cereals in an excellent manner*

Vitamin A is present in grains in only small amounts The vitamins of the B complex are contained in abundance in the whole grain but they are removed almost entirely *in the process of milling* This explains the efficacy of brown rice in preventing beriberi Grains ordinarily contain practically no vitamin C, but when permitted to germinate they *develop this vitamin The whole grain contains vitamin E which is* especially abundant in wheat germ oil

The mineral constituents of grain are held chiefly in the embryo and in the outer layers of the kernel White wheat flour contains only from about one tenth to one fifth of the ash found in the whole grain It is especially poor in calcium, iron, sodium, phosphorus and chlorine The mineral deficiencies of the other grains are about the same, except that oats have more calcium

Among the other substances, the cellulose of the outer layers of the kernel is sometimes of value as a stimulant to peristalsis The laxative effect of bran however, is not due alone to cellulose, but also to some extent to the oil of the grain and perhaps to still other unknown laxative substances

*Whole wheat* and similar flours have become popular because of their superiority in protein vitamin and mineral content, as well as because of their laxative properties Such flours are of value but certain practical considerations should not be disregarded *In the first place* whole wheat and graham flours are not so completely digested as the finer flours and to a person with a delicate digestion they may present an unnecessary burden Then, too the former are much inferior to the latter *in keeping qualities In the present stage of civilization it is necessary* that grain products be transported great distances and kept for long periods for these reasons products made from the whole grain can never really take the place of the more highly milled flours Whole wheat contains many needed nutrients which are signally lacking in white flour but it is by no means a perfect food and the semi invalid cannot make up for all his dietary and *other faults* merely by eating whole wheat bread From British sources[16] comes the following comment

> In advocating whole meal bread for general use whether in times of need or *in times* of plenty not only men but also women and children are concerned and all the experiments on which the arguments are based have been carried out on animals or ... diets and for some brown ... ving constipation Appetite ... t no one who dislikes a food ... oided

To eat the whole grain is proper if it is agreeable and well borne, but the person who fears the dangers of vitamin and mineral deficiencies may safely indulge in the enjoyment of white bread if it is made from enriched flour, sold in the market as enriched bread

Bread White bread is made of the leavened dough of wheat flour This dough consists of a mixture of flour, water, lard (or other fat), sugar, salt and some leavening substance

Two types of leavening agent are in general use, compressed yeast and baking powders The former acts on the starch of the flour and the sugar and produces carbon dioxide, this completely permeates the dough and gives it the desirable lightness Baking powder, which consists of a mixture of alum or sodium bicarbonate with tartaric acid or acid phosphate, liberates the same gas with similar results when these agents come in contact with the water of the dough Leavening is also accomplished by forcing water saturated with a gas into the dough or by beating the dough in such a manner as to imprison in it small particles of air

The mass is thoroughly kneaded after which it is permitted to rise still further for a time and then baked

In the baking, three important changes take place the carbon dioxide contained in the dough undergoes further expansion and makes the bread still lighter, the proteins coagulate and "fix" the mass in a light spongy form, and the starch cells and granules burst At the same time there is loss of water, and the starch on the surface undergoes caramelization and other changes which produce an attractive crust

Wheat flour serves best for this purpose because its gluten gives to the dough the proper elasticity Rye approaches wheat in this respect more closely than do the other grains but rye bread is never really light Rice, corn, oats or barley alone will not make this type of bread

If bread is baked in large masses it is known as loaf bread if in small pieces, as rolls If milk (or milk solids in the proportions to form milk) is used to replace a part of the water of the dough, it is called milk bread Because of the supplementary value of milk proteins, the addition of even this small amount of milk adds greatly to the nutritive value of the bread Other forms of bread, such as corn bread or rye bread, are made by replacing wheat flour in part or in whole with other flours

Biscuits, which are usually eaten hot, are made with baking powder and contain more fat than light bread Muffins are lighter than biscuits, they usually contain egg, more milk and sometimes a little sugar Crackers sometimes called biscuits, are made from dough which has little or no leavening and which is rolled thin before being baked, they often contain more fat than bread and occasionally are flavored, salted or sweetened, they are particularly digestible because, being dry, they must be thoroughly masticated before they are swallowed

When sugar, egg, spices and other seasonings are added to the dough, it becomes cake, when there is a large amount of lard or butter, it becomes pastry

The fear of hot breads, such as rolls, biscuits and muffins, is probably

**Table 31 Vitamin Content of Whole Grains**

(A majority of samples of whole grains contain the indicated nutrients in amounts within the following ranges)

*(Data Compiled by the Food and Nutrition Board National Research Council[17])*

| Product | Thiamine | Riboflavin | Niacin |
|---|---|---|---|
| | (Expressed as Mg per 100 Gm) | | |
| Wheat, whole | 0 44 to 0 66 | 0 09 to 0 20 | 5 4 to 8 0 |
| Corn, whole | 0 37 to 0 58 | 0 08 to 0 24 | 1 7 to 2 7 |
| Oats | 0 66 to 0 88 | 0 12 to 0 17 | 0 88 to 1 8 |
| Rice | 0 33 to 0 56 | 0 08 to 0 25 | 4 4 to 6 6 |

VITAMIN CONTENT OF PREPARED CEREAL FOODS

| Product | Manufacturer | Thiamine | Riboflavin | Niacin |
|---|---|---|---|---|
| Products derived from wheat | | | | |
| All Bran | | 0 37 0 52 | 0 36 to 0 48 | 16 0 to 18 5 |
| Post's Bran Flakes* | | | | 7 5 to 9 0 |
| Chef White Wheat Cereal | | | | 1 0 |
| Coco-Wheats* | Company | 0 39 to 0 48* | 0 07 | 1 9 to 2 3* |
| Cracked Wheat | Doughboy Mills Inc | 0 44 | 0 16 | 4 4 |
| Cracked Wheat | IOA Foods | 0 40 | 0 17 | 4 5 |
| Cream of Wheat† | Cream of Wheat Corporation | 0 41 to 0 68* | 0 06 to 0.10 | 1 6 to 2 0* |
| Farina† | Pillsbury Flour Company | 0 40* | 0 05 | 2 0* |
| Force | The Best Foods Inc | 0 04 | 0 16 | 4 1 |
| Grape Nut Flakes* | Post Products | 0 52* | 0 17 to 0 26 | 4 9 to 5 6 |
| Grape-Nuts Wheat Meal* | Post Products | 1 02* | 0 12 | 5 1 |
| Grape-Nuts* | Post Products | 0 81* | 0 17 to 0 20 | 3 9 to 4 9 |
| Hecker's Cream of Farina† | The Best Foods, Inc | 0 40* | 0 06 | 2 4* |
| Krumbles | Kellogg Company | 0 02 to 0 07 | 0 16 to 0 21 | 4 2 |
| Maltex Cereal | Maltex Company | 0 35 | 0 13 to 0 17 | 4 5 |
| Malt O Meal* | Campbell Cereal Company | 0 40 to 0 60* | 0.25 to 0 32* | 2 7 to 3 3* |
| Pep* | Kellogg Company | 1 2 to 1 5* | 0 16 to 0 25 | 4 5 to 6 5 |
| Puffed Wheat Sparkies* | Quaker Oats Company | 0 40 to 0 54* | 0 12 to 0 16 | 8 4* |
| Ralston Whole Wheat Cereal‡ | Ralston Purina Company | 0 53 | 0.14 | 4 0 to 5 1 |
| Rolled Wheat | Doughboy Mills, Inc | 0 37 | 0 13 | 4 1 |
| Rolled Wheat | IOA Foods | 0 32 | 0 14 | 4 0 |
| Rolled Wheat (Pettijohn's) | Quaker Oats Company | 0 31 to 0 40 | 0 13 to 0 16 | 3 8 |
| Shredded Ralston | Ralston Purina Company | 0 11 to 0 16 | 0 13 | 4 3 |
| Shredded Wheat | Kellogg Company | 0 19 to 0 23 | 0 14 to 0 19 | 4 5 |
| Shredded Wheat | National Biscuit Company | 0 24 | 0 13 to 0 15 | 4 2 |
| Shreddies | National Biscuit Company | 0 20 | 0 12 | 4 0 |
| Wheatena | Wheatena Company | 0 06 to 0 13 | 0 15 | 4 0 |
| Wheaties* | General Mills Company | 0 39 to 0 60* | 0 19 to 0 22* | 4 1 to 5 1 |
| Wheatsworth | National Biscuit Company | 0 50 | 0 13 | 4 8 |
| Products derived from corn | | | | |
| Corn Flakes* | Kellogg Company | 0 39 to 0 45* | 0 08 | 1 6* |
| Corn Flakes* | Post Products | 0 28 to 0 40* | 0 10 | 1 3 |
| Kix* | General Mills Company | 0 44 to 0 59* | 0 10 to 0 20 | 2 1 to 2 7* |
| Products derived from oats | | | | |
| Cheer oats* | General Mills Company | 0 84* | 0 25* | 2 0* |
| H O Quick Oats | The Best Foods Inc | 0 67 | 0 17 | 0 85 |
| Mother's Oats | | 0 61 | 0 17 | 0 85 |
| Quaker Oat es* | | * | 0 11 to 0 15 | 0 60 to 0 7 |
| Quick Quaker Oats | | | 0 14 to 0 18 | 0 83 to 1 0 |
| Products derived from rice | | | | |
| Cream of Rice | Grocery Products Mfg Company | 0 16 | 0 08 | 1 7 |
| Cream of Rice* | Grocery Stores Product Sales Co Inc | 0 94* | 0 62* | 6 3* |

Table 51 Vitamin Content of Whole Grains *(Continued)*

| Product | | Thiamine | Riboflavin | Niacin |
|---|---|---|---|---|
| | | (Expressed as Mg per 100 Gm) | | |
| Puffed Rice Sparkies* (new) | Quaker Oats Company | 0 64* | 0 06 | 4 6* |
| Rice Krispies* | Kellogg Company | 0 45* | 0 07 | 8 0* |
| Rice—Natural Brown | Comet Rice Mills | 0 41 | 0 09 | 4 4 |
| Products not otherwise classified | | | | |
| Cerevim*‡ | Lederle Laboratories | 2 1* | 3 3* | 20 3* |
| Cream of Rye | Fruen Milling Company | 0 12 | 0 17 | 0 92 |
| Life of Wheat—Wheat Germ | Life of Wheat Company | 2 3 | 1 0 | 4 5 |
| Scotch Brand Barley (Pearled) | Quaker Oats Company | 0 15 | 0 07 | 2 1 |
| Soya Wheat | Soya Wheat Company | 0 71 | 0 27 | 3 4 |
| Viobin Wheat Germ | Viobin Corporation | 3 0 | 1 2 | 5 5 |

* Restorative addition of synthetic vitamin or vitamin concentrate

† Enriched with synthetic vitamins or vitamin concentrates to conform with proposed federal standards of enrichment

‡ Added wheat germ

not justified If they are light and properly made and are slowly eaten, they are probably as digestible hot as cold

*Enriched bread* is made by the use of enriched flour or enriched yeast or by direct addition of the required substances to the dough To meet the proposed minimum standards this bread must contain per pound thiamine, 1 1 mg, riboflavin, 0 7 mg nicotinic acid, 10 mg, and iron, 8 mg

**Breakfast Cereals** Almost all grains have been prepared in some special form to be eaten as breakfast food, they are usually taken with cream or milk

In the process of manufacture the grains are subjected to various changes Sometimes the kernel is merely husked and lightly 'cracked,' as in cracked wheat and Scotch oatmeal, at other times it is finely ground and all the outer layers are removed, as in farina In some, the grain is caused to pop open while being cooked under pressure, as in puffed rice or puffed wheat, or, after being partially cooked, it is flattened between rollers, as in rolled oats In others a dough made of the finely ground grain is pressed into flakes and baked, as in corn flakes Sugar and other substances are sometimes added Some cereal foods have been subjected to artificial digestion Some are ready to eat others must be cooked a long time Their number is legion Oatmeal and rolled oats are the best

The nutritive value of breakfast foods is sometimes improved by the addition of a wheat germ concentrate (B complex) or by irradiation (vitamin D) Unless something has been added, however, the value of the breakfast food is simply that of the grain part or whole, from which it comes Studies of the nutritive value of these foods at the University of Rochester indicate that 'the differences in rates of passage and absorption . are of little importance for a well person The slightly longer digestion time required by oats is of small consequence in a normal individual So also is the retarding effect of the presence of bran,

indeed, the presence of a small amount of roughage seemed to facilitate the emptying of the stomach perhaps by aiding the breaking up of a compact gelatinous mass." These studies suggest that for actual value to the body, rolled oats rank first and "wheat endosperm" next, while "toasted corn endosperm" and "whole wheat" tie for third place.

The advantage of these breakfast foods is not alone in their attractiveness and palatability, but chiefly in the necessity for taking milk or cream with them, the proteins of milk supplementing in a satisfactory manner those of the cereals. The disadvantage is in their cost; they are by no means economical. The puffed and flaked grains are light and therefore carry relatively little nutrient for their bulk. Those sold in bulk are obviously the more economical. The puffed cereals and other types prepared by high temperature treatment usually undergo changes in their protein of a nature which reduces its biologic value.

### SUGARS AND SUGARY FOODS

**Sucrose.** Sucrose, or cane sugar, a disaccharide, is the form in which sugar is largely eaten. Most fruits and fruit juices derive their sweetness from a mixture of this and certain of the simpler sugars, such as dextrose and fructose. The sugar of commerce is derived almost exclusively from the juice of the sugar cane and the sugar beet; by a process of refining, the sugar is permitted to crystallize out of the syrup and is brought to a high degree of purity and crystalline whiteness.

Cane sugar on hydrolysis (as in cooking with dilute acids) is split into two hexoses, dextrose (glucose) and fructose (levulose). Under the influence of heat, it also has a tendency to undergo certain physicochemical changes which result in caramel; this gives a darker color to its solution.

**Dextrose.** Dextrose (glucose, grape sugar) is a simple hexose found in fruits and fruit juices; it is abundant also in honey. The glucose of commerce is obtained largely by hydrolysis of corn syrup. It has become a widely used sweetening agent. Glucose has nearly as sweet a taste as cane sugar and is equally nutritious. In fact, sucrose and all starches must be hydrolyzed by digestion to dextrose or to a similar hexose before they can be utilized by the organism. Glucose is the form in which the carbohydrate of food circulates in the blood.

**Lactose.** Lactose has the advantage of being less sweet than cane sugar, but has the same caloric value. It is readily assimilated by the infant, but the researches of Hosoi indicate that its laxative effect in the adult interferes with absorption.

**Molasses.** Molasses is a syrupy liquid obtained from the juice of the sugar cane after some of the sucrose has been removed by crystallization. It is essential that the molasses be withdrawn at a relatively early stage in the process of sugar making ("first molasses"), for the syrupy liquid, known as "refiner's syrup," which remains at the end of the process contains little sugar and, taken alone, is not an edible product. True molasses contains much of the sucrose as well as the ash and other constituents of cane juice. It is an excellent source of both calcium and iron. The final molasses end product from which sugar crystals are separated is known as "black strap molasses." This unattractive material

is used primarily for fermentation industries and cattle feed It is endowed with no special or mystical properties to justify the widespread attention provided it by some recent food faddists

**Cane Syrup** This is widely eaten in the South and used in infant feeding It is an attractive palatable product made from the juice of the cane by boiling it in an open kettle until the proper consistency is obtained All the constituents of the original cane juices are retained although some of the sucrose is split into simpler sugars

**Maple Syrup** This is also a palatable syrup It is made from the sap of the sugar maple and the process of manufacture is similar to that of cane syrup

**Mixed Syrups** Mixed syrups are usually made by the addition of glucose (from corn) to refiner s syrup a by product of sugar manufacture which contains all the ash and other constituents but little of the sugar of cane syrup It must be labeled as such It is a good food but is not so highly prized as the other syrups

**Honey** Honey contains a mixture of various sugars which have been obtained from flowers by the bee It also contains—and this contributes greatly to its flavor—aromatic substances reminiscent of the flowers from which it comes There is a detectable difference in the honey from different flowers The chief sugars of honey are fructose and dextrose with a relatively small amount of sucrose Attempts to imitate and adulterate honey are made with solutions of commercial glucose and other substances

**Preserves Jams and Jellies** Fruits may be preserved by the addition of sugar In preserves the fruit usually retains something of its original form Jams and marmalade are made by cooking fruits with the addition of sugar down to a soft mass in this process much of the sucrose is split into simpler sugars Jellies do not include the pulp they usually contain merely the juice of the fruit which carries with it the sugars and certain other substances Pectin which is present in fruits before they are thoroughly ripe helps the mass to jell In the manufacture of jellies pectin is usually added The food value of these products is due largely to the added sugar Their attractiveness comes from the flavor of the fruit

**Candies** As a rule candies are made from sucrose with the addition of other substances such as chocolate and various flavoring extracts as well as materials which give it the proper consistency They are made also from glucose

**Place of Sugar in the Diet** The great value of sugar lies in the fact that it offers in a concentrated form readily available carbohydrate Properly taken it throws little burden on the digestive organs and is quickly utilized Persons who have been accustomed to sugar in the diet find it unpleasant to get along without it even when an abundance of other carbohydrate is available Sugar is of value in feeding the sick when a readily assimilable carbohydrate is desired

Another advantage of sugar is its satiety value[18] Experience has shown that something sweet at the end of the meal gives an added sense of satisfaction Even the obese who must curtail their food rigidly can make use of this fact by adding a simple dessert to their main meal they may

get along with a smaller total intake and still enjoy a feeling of faction.

On the other hand, the abuse of sugar is commonplace. Substitu especially by children, of this highly refined source of Calories for stuffs which carry a greater variety of nutrients is to be condemne sugars and sweets should supply a major share of the Calories o diet, one would expect severe malnutrition to result. Such, inde observed in extreme cases of children with malignant malnutriti Costa Rica who have subsisted largely upon the residue from sugar duction.

Reduction of consumption can usually be recommended on the of need for restricting caloric intake. That obesity is the most prev form of malnutrition in the United States today is widely accepted reducing the caloric intake it is desirable to maintain the intake of nutrients at an abundant level. This implies reduction in Cal through removal from the diet of such foods as supply Calories un ciated with other essential nutrients—obviously, sugar falls into category.

The association between high dental caries rate and free sugar in diet is at least suggestive of a benefit to be derived from drastic cu ment of consumption of sugar.

## LEAFY VEGETABLES

The chief value of the leafy vegetable lies in its vitamin and mir content. McCollum has called attention to the fact that in both table and animal tissues the most actively functioning part contains vitamins. In this connection, he calls attention to the difference in f tion between the leaf and the seed: the functional activity of the for is great, while the latter, being largely a storage organ, experiences l metabolic activity. Leaves that are thin and contain the most chl phyll are richest in vitamins. In cabbage or lettuce, for instance, thin, green outer leaves rank much higher in this respect than the i leaves, which are of lighter color. Green leaves are especially ric vitamin A, and in this they rank next to milk. They also contain abundance of ascorbic acid and riboflavin and a somewhat sm amount of thiamine. The leaf is a good source of calcium and p phorus and is of great importance as a source of iron. Sherman s that in proportion to cost, fruits and vegetables provide more iron t meat and fish and that in them this element is more completely avail

The other nutritive elements—carbohydrate, protein and fat—w the leaf offers are small in amount. While there is considerable c lose, the available carbohydrate is less than 5 per cent. The protei the dried leaf varies; cabbage and the leaf of the turnip, when contain a fairly good percentage of protein. It is said that the prot of the leaf supplement to a certain extent those of the seed.

Lettuce, broccoli, cabbage, turnip greens and beet greens, which addition to spinach, are the leafy vegetables commonly eaten in Amer are also valuable sources of vitamin and mineral elements. Cauliflo

while properly a flower is usually classed with the leafy vegetables because its properties are the same

In the cooking of vegetables a part of the contained minerals is taken up by the cooking water If the water is discarded appreciable amounts of iron magnesium and phosphorus and smaller amounts of calcium and magnesium are lost in this way Portions of the water soluble vitamins $B_1$ $B_2$ and C are also lost in this way vitamin C is likely in addition to undergo actual destruction Comparatively little of the vitamin A value is lost through cooking

### SEED VEGETABLES OR LEGUMES

Chief among legumes are beans and peas These plants have the peculiar property of being able to utilize the nitrogen of the atmosphere for the synthesis of protein and their value lies largely in their richness in protein Whereas grains contain only about 10 or 12 per cent of protein the legumes contain about 23 per cent In their dry state they contain pound for pound an even greater amount of protein than meat

While the proteins of legumes are of higher quality than those of cereals there is as a rule something lacking in their structure which limits their availability In their studies of biologic values Everson and Heckert[19] found an appreciable difference in the growth promoting qualities of various legumes They state that each source of leguminous protein likewise varies in biologic value according to the condition (fresh mature and so on) and the method of preparation Many legumes are lacking in cystine They have the power however to supplement in a satisfactory manner the cereal proteins this is particularly true of wheat and peas and of wheat and soybeans

The legumes are also rich in carbohydrate and contain a small amount of fat The large amount of hemicellulose in beans often leads to intestinal fermentation and flatulence

The vitamin content of legumes varies somewhat They are as a rule lacking in vitamin A all contain an abundance of thiamine and smaller amounts of riboflavin They offer a good supply of iron and phosphorus but are usually deficient in calcium sodium and chlorine

The canning of peas and beans especially of the former is an industry of increasing proportions When properly canned or frozen these legumes are desirable food and constitute a staple article of diet

The *soybean* deserves special mention because the dry seed contains about 34 per cent of protein of high biologic value In human subjects Cahill and his associates[20] found the average digestibility of the protein in cooked whole soybeans in cooked soybean flour and in soybean milk to be 90 5 94 0 and 89 6 per cent respectively Using the protein of whole egg as a standard they found the average biologic value of soybean protein in the cooked flour to be 95 3 per cent Vail and Smull[21] write of the variety of ways in which soybean and its products can satisfactorily be used in the menu They state that the use of limited amounts of soybean flour in many products rather than large amounts in a few

is a desirable practice They tell of a number of products in which the wheat flour can be replaced advantageously by soybean flour to the extent of 10 to 12 per cent

## ROOTS AND TUBERS

The *white potato* is one of the most staple foods It consists approximately of three fourths water and one fourth nutritive substance more accurately, it contains about 20,per cent carbohydrate 2 per cent protein, 1 per cent ash and 77 per cent water Structurally, it consists of a thin, corklike peel within which may be distinguished three layers an outer cortical layer, ½ inch or less in thickness, and two medullary layers The outer medullary layer is thicker and more important The inner layer is irregular in outline and contains a larger percentage of cellulose The medullary layers may be likened to the endosperm of the seed in that each serves merely as a storage organ The carbohydrate of the potato is largely in the form of starch granules stored in cells the walls of the cells are of cellulose As the potato matures much of its contained sugar is converted into starch as it grows older the reverse takes place Thus it is evident that there is more sugar in very young and in very old potatoes than in those which are recently matured

The proteins of the potato are of excellent quality Although the results of animal experiment have not always been in agreement observations on man especially those of Hindehede confirm this belief further confirmation is seen in experiments reported from the biochemical laboratory in Cambridge England which indicate that tuberin the globulin of potato is of exceptionally high biologic value

The great value of white potato as a food lies in the fact that at a low cost it furnishes an abundance of carbohydrate with a small amount of readily assimilable protein and that it is an excellent source of mineral elements It is also a dependable though not rich source of vitamins

*The sweet potato* does not belong in the same botanical classification as the white potato but as a food it presents similar properties The chief difference is that it contains 5 per cent or more of sugar and amounts of carotene which vary from variety to variety

The *carrot* is of value chiefly because of its vitamin content Like many other yellow pigmented food products it is relatively rich in vitamin A

The *beet* is of value chiefly because of its yield of sugar and the vitamin richness of its leaves

The value of the *turnip* lies in its antiscorbutic properties as well as in the vitamin and mineral content of its leaves

## STEMS AND BULBS

*Celery* is commonly eaten as a salad The green leaves contain a fair amount of vitamins but little is known of the nutritive value of the stalk

*Asparagus* is eaten as a vegetable and salad and has considerable nutritive value

*Onions* contain vitamin C and also fair amounts of vitamin $B_1$. Onions, raw or cooked, are used to give flavor to other foods.

The *tomato,* although eaten as a vegetable, is in reality a fruit. Because of its richness in vitamins, its popularity is constantly increasing. Both raw and canned, it is a dependable source of vitamin C. The fact that the tomato retains its vitamin C even when canned makes it especially useful Canned tomato juice can with impunity be given to very young infants, and it will prevent scurvy.

## YEAST

*Brewers' yeast* is an excellent source of protein of high biologic value and of the vitamins of the B complex It has successfully been included in bread, cakes, meats and other foods In the rations of his experimental animals, Sure[22] blended brewers' yeast with enriched flour to the extent of 1, 3 and 5 per cent and obtained best gain in weight and utilization

**Table 52 Nutritive Value of Proteins in Various Foods as Estimated by the Nitrogen Retention Method** (Loescke[23])

| | Whole Yeast Powder | Meat | Whole Egg | Whole Milk | Defatted Soybean |
|---|---|---|---|---|---|
| Protein (N x 6 25), % of total solids | 49 | 63 | 50 | 37 | 54 |
| Coefficient of digestibility, % | 75 | 98 | 100 | 100 | 86 |
| Biologic value, % | 74 | 72 | 94 | 85 | 77 |
| Over all nutritional value, %* | 55 | 71 | 94 | 85 | 66 |

* Coefficient of digestibility × biologic value

**Table 53 Approximate Cost of Yeast Protein in Comparison with Other Proteinaceous Foods*** (Loescke[23])

| Product | Cost per Pound | Protein Content | Approximate Cost of Protein per Pound |
|---|---|---|---|
| | $ | % | $ |
| Yeast, dry (5% moisture) | 0 40 | 50 0 | 0 80 |
| Soybean flour (low fat) | 0 0482 | 40 0 | 0 120 |
| Soybean flour (high fat) | 0 0605 | 35 4 | 0 171 |
| Whole milk (dry)† | 0 3313 | 26 9 | 1 23 |
| Milk solids not fat (dry) | 0 1625 | 35 4 | 0 458 |
| Cheese | 0 2325 | 24 4 | 0 953 |
| Salmon, canned | 0 3125 | 20 8 | 1 50 |
| Eggs, dried | 1 13 | 46 5 | 2 43 |
| Beef, choice | 0 22 | 21 3 | 1 03 |
| Pork, loins | 0 259 | 16 6 | 2 56 |

* Prices will vary with time and section of the country, but those given represent prevailing prices on the same market at time of compilation and are deemed satisfactory for comparable purposes

† Spray dried vacuum packed

of protein from the 5 per cent mixture. He quotes calculations to the effect that 2 tablespoons of dried brewers' yeast will provide 10 per cent of the daily adult needs of protein, 100 per cent thiamine, 25 per cent of the riboflavin and 45 per cent of the niacin. When it is desired to give additional vitamins of the B complex and to add to the protein quota of the diet, this food can profitably be incorporated in the other foods (Tables 52 and 53).

## FRUITS

Fruits are of value because of their laxative and base-forming properties and their vitamins, as well as for their attractive flavor. Their caloric value, which is limited, depends largely on the amount of sugar which they contain. All fruits supply some ascorbic acid.

The *apple* carries small amounts of vitamins A, $B_1$, $B_2$ and C. It has definite laxative properties, probably owing to the large cellulose content. The young apple contains a large amount of starch, but as it ripens, the starch is rapidly converted into sugar; a fully ripe apple contains little or no starch. The acid content decreases as the sugar increases. In like manner, its pectin, valuable in the formation of jelly, decreases with the ripening process.

The *citrus fruits* offer an excellent source of ascorbic acid and readily assimilable dextrose. For this reason orange juice is used when there is need for a quickly assimilable carbohydrate.

Orange juice is given to infants and children almost as a routine for the prevention of scurvy. All processed orange juice accepted by the Council on Foods and Nutrition of the American Medical Association must supply a minimum of 40 mg. per 100 cc. of retained naturally occurring ascorbic acid.

The base-forming property of citrus fruits is important. Their acids do not increase the acidity of the body; in fact, the reverse is true. The acid salts of the organic acids, such as potassium citrate, which are found in fruits, undergo oxidation, and there is left merely the base to be excreted in the urine. Therefore, contrary to popular belief, the acid fruits, such as the orange, lemon and lime, are base-forming and not acid-forming in their tendencies.

*Peaches, pears, plums, prunes, cherries* and *apricots* all present in a greater or less degree the same laxative, antiscorbutic and base-forming properties as other fruits. Apricots, peaches, prunes and raisins, both fresh and dried, have been found to have good blood-building qualities.

The *banana* has not been accorded the place in the diet to which it is entitled. When fully ripe, it is a most valuable addition to the diet of young children, particularly those for whom a gain in weight is desirable.[24] It can also be given to infants. This fruit, when unripe, consists largely of starch and therefore is difficult to digest; as the ripening process goes on, however, a large part of the starch is converted into sugar. Therefore, bananas should be fully ripe if they are to be eaten raw, the peel should show the black discoloration which appears just before the fruit is over-ripe. Cooked bananas are easily digested.

The so-called *small fruits,* strawberries, raspberries, blackberries, gooseberries, cranberries and currants, have the same advantages as other

fruits. Raspberries are especially rich in vitamin C. Strawberries are consumed in largest quantity.

*Olives* are eaten as a relish rather than for the nutritive value of their oil. Ripe olives canned in dilute salt solution (botulism!) are preferable to olives pickled in brine.

*Fruit drying* has become an important industry. In California peaches, apricots, prunes and raisins are prepared by drying the fruits in the open air. Among these, prunes and raisins are the most important commercially.

*Canned fruits* are prepared in large quantities. Pineapple, sliced and canned in syrup, has become a popular food. Vitamins A and B are well preserved in the process of canning.

## NUTS

Nuts are as a rule rich in protein and fat and poor in carbohydrate. The chestnut, because of its richness in carbohydrate, forms an exception. Nuts are poor in vitamins A and C but contain a fair amount of the B complex. They are good sources of iron, copper and manganese but as a rule are lacking in calcium.

Table 54. Average Composition of Some Commoner Nuts (Chatfield and Adams[13])

| Kind of Food | Constituents of Edible Portion | | | | | | |
|---|---|---|---|---|---|---|---|
| | Water | Protein | Fat | Ash | Carbohydrate | Fiber | Fuel Value per 100 Grams |
| | Per cent | Per cent | Per cent | Per cent | Per cent | Per cent | Calories |
| Almonds, dried | 4.7 | 18.6 | 54.1 | 3.0 | 19.6 | 2.7 | 640 |
| Brazil nuts | 5.3 | 14.4 | 65.9 | 3.4 | 11.0 | 2.1 | 695 |
| Butter nuts | 3.8 | 23.7 | 61.2 | 2.9 | 8.4 | | 679 |
| Chestnuts, fresh | 53.2 | 2.8 | 1.5 | 1.0 | 41.5 | 1.1 | 191 |
| Cocoanuts, fresh | 46.9 | 3.4 | 34.7 | 1.0 | 14.0 | 3.2 | 382 |
| Hickory nuts | 3.5 | 13.9 | 67.4 | 2.0 | 13.2 | 2.2 | 715 |
| Peanuts, roasted | 2.6 | 26.9 | 44.2 | 2.7 | 23.6 | 2.4 | 600 |
| Pecans | 3.0 | 9.4 | 73.0 | 1.6 | 13.0 | 2.2 | 747 |
| Walnuts, black | 2.7 | 18.3 | 58.2 | 2.1 | 18.7 | 1.9 | 672 |

Observations on fruitarians who have lived largely on fruits and nuts have led to the belief that nut proteins are of high biologic value. Johns and Finks[25] found that peanut flour was an efficient and palatable supplement to whole wheat flour. Because the fat content of the peanut is high (50 per cent) and the protein not excessive (31 per cent), Smith and Wilder[26] recommended this nut for diabetic patients. Less favorable is the opinion of Mitchell and Beadles[27] who determined the relative digestibility and biologic values of the proteins of beef round and of five nuts, Brazil, cashew, almond, filbert and English walnut. They

concluded that beef protein is superior in both, particularly to the proteins of the nuts studied, although the cashew nut, with a digestibility of 96 per cent and a biologic value of 72, was not regarded as greatly inferior. All other nuts exhibited biologic values ranging from 50 to 60. This is somewhat in accord with the views of McCollum and Simmonds, who state, as a reminder, that nuts are properly to be regarded as the seeds of plants and should not be expected to supplement cereals, legumes, tubers or fruits except in respect to the protein content. They say: "A diet composed of such combinations of food may be balanced so far as chemical analysis can show but be defective in other respects."

Nuts are regarded as indigestible. True, their compact physical state and their richness in fats may retard the emptying of the stomach and cause discomfort. But the reverse may also be true, and if they are well masticated, this retarding influence will often give a sense of satiety and comfort. When nuts are thoroughly masticated and eaten with fruits and other foods, their nutritive constituents are well utilized.

## FATS

The most important fatty foods are butter and cream; they present fats in the most palatable and most easily assimilated form. They have been discussed with milk.

**Butter Substitutes.** A good substitute for butter must be free from all foreign taste and odor and must have a melting point identical with that of butter.

*Oleomargarine* is the most widely used and acceptable butter substitute. It is a mixture of several fats blended and treated in such a manner as to give the consistency and appearance of the food which it imitates. Its basis is derived from beef fat after the unsuitable fats with lower melting points, such as stearin and palmitin, have been removed. To this oil are added a certain amount of neutral lard and occasionally other fats, such as those obtained from the cottonseed, coconut or peanut. There is also added in most instances fish liver oil in amounts sufficient to contribute 15,000 international units of vitamin A per pound. This mixture is churned with milk or with true butter until a homogeneous mass is obtained. It is then cooled, salted and "worked" as butter. The consumption of oleomargarine in America is about one fourth that of butter; it is increasing.

A comparison of the nutritive value of butter and oleomargarine is the subject of an exhaustive bulletin by the Council on Foods and Nutrition of the American Medical Association.[28] The report is summarized in part by the statement:

> It is therefore possible to conclude that at present there is no scientific evidence to show that the use of fortified oleomargarine in an average adult diet would lead to nutritional difficulties. A similar statement is probably justified in the case of growing children, but preliminary results from animal experiments indicate that more work is necessary before any specific conclusions can be made.

A similar conclusion was reached by Cowgill,[29] who writes that experiments with successive generations of rats show that, in an otherwise

satisfactory diet, a vegetable fat such as that containe
can serve adequately in place of butter for growth and
*Other substitutes for butter* are made from various ve
eral of these have been studied by Deuel and his co work
that rats grow equally well whether the fats of the ra
from butter margarine corn cottonseed peanut or so
fats with higher melting points are removed by cooling ar
as a residue there is obtained a mixture which approxin
consistency and melting point The chief difficulty here
a product which in taste and flavor resembles butter ra
original mother substitute

**Lard** Lard is made by a refining process from the leaf f
and consists of about 99 per cent fat It is used largely in co
substitutes for lard are in use some of which are distinctly s
*Cottonseed oil* comes first By a process of chilling and
residue of heavier fats is obtained which can with advantag
tuted for lard This residue represents about one fifth of the
Other substitutes are made by mixing cottonseed oil directl
heavier fats of oleo oil Cottonseed oil is similar in appearance
to olive oil In preparation for human consumption it is refine
improve its flavor greatly and to make of it a thoroughly ed

**Olive Oil** The oil of the olive is obtained from the ripe f
flavor and appearance depend on several factors the kind of ol
its ripeness when gathered and the process of manufacture For
oil the olives should be gathered at the right stage of ripeness
time about 50 per cent of the fruit is oil which when the skin is
exudes spontaneously This represents the highest grade and is
virgin oil The pulp which remains when subjected to pressure
yields a liberal quantity of oil which is classed as second grade
other grades are obtained by further treatment of the pulp Th
is immediately filtered and is then allowed to stand for several mo
Olive oil is much desired chiefly as a salad dressing Beyond its a
able flavor however it has little advantage over the other edible v
table oils There are numerous substitutes and imitations many of th
consist of cottonseed oil or mixtures of cottonseed oil with the lo
grades of olive oil

**Peanut Oil** Peanut oil is coming into wider use It is similar to oli
oil but has a tenacious characteristic flavor

**Corn Oil** Corn oil is used largely in the trades and arts and also i
feeding cattle It is coming into favor as a food for man

**Place of Fats and Oils in the Diet** The necessary caloric value of the
diet cannot easily be obtained without the inclusion of fat for this food
stuff yields more than twice as many calories as the same quantity of
carbohydrate or protein The richness of certain fats notably butter
cream and the fish oils in vitamins particularly vitamin A adds greatly
to their desirability In animal experiment it has been shown that
tain unsaturated fatty acids are essential to growth an
nance of health 31

Fatty foods are beli ed

amount of fat in the diet of susceptible persons will cause intestinal disturbances Much depends however on the nature of the fat Those fats which melt at the temperature of the body are most easily assimilated while those with a high melting point (stearin) are poorly utilized It is possible however to mix widely differing fats in such proportions as to obtain a product which has the proper melting point and therefore is readily assimilated

Fatty foods leave the stomach slowly and in susceptible persons will cause a feeling of weight and heaviness On the other hand retardation of emptying time may lead to a desirable sense of comfort and satisfaction This increase in the satiety value which fat gives to a meal is important Warning however should be given against the eating of improperly fried foods since they are often so thoroughly impregnated with fat as to prevent ready access of the digestive fluids The role of fat in the diet has been the subject of an exhaustive review by Anderson and Williams [32]

## FOOD ADJUNCTS CONDIMENTS

*Table salt* is a fine white crystalline substance containing about 99 per cent of sodium chloride To prevent caking through the absorption of moisture some other substance such as starch is often added For the benefit of those whose food and water are lacking in iodine a minute amount of potassium iodide also is sometimes added

Salt gives zest to many foods which otherwise would be tasteless in proper amounts it brings out the natural flavor of food but if eaten in excess it masks this flavor and eventually blunts the person s finer sense of taste Excessive consumption of salt which is a frequent dietary fault may be injurious

Sodium chloride is not merely a food adjunct it is a necessity for the natural foods supply an insufficient amount to meet the animal s needs I have seen a salt free diet—one in which literally no salt was added to the food—lead to marked weakness Uremia has been reported due to sodium depletion [33] Wild animals will travel long distances to reach a salt lick and primitive races have gone to war for want of salt

For the average person 2 gm daily of added salt are sufficient this includes both that supplied in the kitchen and that taken at the table

*Vinegar* is a dilute solution of acetic acid and other substances It is used to soften the fiber and to give a sour flavor to many foods which ordinarily have little taste It was originally made from apple cider through alcoholic fermentation and the subsequent formation of acetic acid Now it is made also from barley and other cereals as well as by dilution of concentrated solutions of acetic acid to which are added flavoring and coloring materials Vinegar should contain not less than 4 per cent of acetic acid

As a rule *spices* contain some volatile oil which adds piquancy to the food Allspice anise cinnamon cloves ginger horse radish mustard nutmeg mace paprika and pepper are commonly used Taken sparingly they are of value their abuse is disastrous to the taste

*Flavoring extracts* are alcoholic solutions of the savory or fragrant principle of aromatic plants The flavor which they give to the food often depends as much on the odor as on the actual taste Vanilla and lemon extracts are widely used Others are cinnamon ginger almond peppermint orange and wintergreen

BEVERAGES

**Coffee and Tea** *Coffee* is an infusion made from the roasted bean of *Coffea arabica* or *Coffea liberica* It is taken chiefly for the stimulating effect of its alkaloid caffeine and also because of the pleasantly aromatic flavor which comes from its volatile oil coffeol

The manner in which coffee is made determines largely its flavor and strength whether by boiling steeping percolation or filtration The making of good coffee is an art

*Tea* is an infusion of the leaves and leaf buds of the tea bush Thea The cheering and mildly invigorating effect of this drink like that of coffee comes from caffeine The quantitative relation of this alkaloid to the tannin which is also present probably determines the quality of the tea good tea should have neither too much caffeine nor too much tannin

There are many grades of tea on the market the flowery pekoe and the orange pekoe are the best The color of the leaves whether green or black depends on the method of preparation Black tea is obtained by a fermentative process which removes some of the tannin To get the best results and avoid an excess of tannin in the making of tea only freshly boiled water should be used and it should not remain in contact with the leaves for more than five minutes

*Effects of Coffee and Tea* Since the physiologic influences of both coffee and tea come from the caffeine which each contains the two can be discussed together Caffeine raises slightly the blood pressure slows and strengthens the heart stimulates renal activity and prevents fatigue and depression The most noticeable effect of tea and coffee is a mild cerebral stimulation they clear away the cobwebs It is doubtful however whether in the long run the mental labor ultimately accomplished can be increased by coffee or tea

The comfort and cheer obtained from a cup of coffee or tea cannot be attributed solely to its caffeine Coffee contains certain aromatic oils which are pleasing to the taste and mildly stimulating to the stomach By retarding slightly the emptying of the stomach it also increases the satiety value of the meal Taken hot these beverages stimulate gastrointestinal motility and when taken cold in hot weather are refreshing

The tannin contained in these beverages especially in tea is believed to interfere with digestion In properly made tea however the tannin is largely if not entirely in combination with caffeine and probably has no harmful effect

The excessive use of coffee or tea is harmful Stimulation and irritation lie close together and caffeine taken in relatively large doses irritates instead of cheers Some dispositions are ruined by caffeine It may produce insomnia True many persons state that coffee or tea will

them to relax and sleep, as a rule, however, this is followed later in the night by a period of insomnia Too much coffee or tea will cause cardiac irritability and produce rapid heart action

The whole civilized world (and much of the uncivilized) drinks coffee and tea Much cheer and comfort is thereby obtained but it cannot be said that through them man s productivity, whether intellectual or physical, is increased When these beverages are taken in moderation no harm is done The tendency today is to rely too much on coffee tea and other drinks containing caffeine

**Cocoa and Chocolate** These beverages are made from the cocoa bean of Theobroma, the cocoa tree After the bean has been roasted and freed from the germ and shell the resulting cocoa nibs are ground and mashed into a solid mass This forms the plain or bitter chocolate of commerce Mixed with sugar, flavoring extracts and other substances, it becomes sweet chocolate If milk is used, it is milk chocolate Cocoa is made by removing from chocolate a part of its fat

Chocolate and cocoa contain an alkaloid theobromine which is akin to caffeine, but does not exhibit its stimulating properties Beverages made from chocolate and cocoa are aromatic and pleasant The oil contained in them has food value but the chief value lies in the milk and sugar which are added The richness of chocolate sometimes interferes with digestion Cocoa forms a pleasing vehicle for milk

**Fruit Juices** Fruit juices are refreshing and because of the sugar they contain, nourishing Grape juice orange juice and lemonade are of value in feeding the sick By the judicious use of such beverages between regular feedings a considerable amount of easily assimilated carbohydrate can be administered

**Mineral Waters** Unbounded faith in the life giving properties of the mineral spring is a thing of the past The time was when mineral waters were credited almost universally with therapeutic powers of marvelous extent Waters which contained the most diverse minerals were believed *to cure some one disease and often a single kind of water was said to be* efficacious in the widest variety of unrelated disorders In many instances these claims were based on faith alone and in others on an erroneous conception of the disease in question Today the general attitude toward mineral waters is more critical

It has long been evident that the medicinal properties claimed for these waters could not possibly rest on their mineral content, as shown by ordinary chemical analysis And yet the continued popularity of many of the spas is such that they must be credited with curative influences of some kind Two factors must be reckoned with (1) the psychic influences and general hygiene of the spa and (2) certain physical properties of the waters The first of these are well known Change of climate, pleasant surroundings good food, absence from work and worry, and rigid adherence to certain rules of hygiene laid down by the *Badarzt,* as well as abiding faith in the efficacy of the water—which faith permeates the entire atmosphere—all taken together account in large measure for the cures accomplished at the various watering places

Mineral waters may be classified as follows [34]

*Alkaline waters* contain sodium bicarbonate often in combination with sodium chloride and with sodium sulfate They are of value in proportion to the alkali contained in them The waters of Capon Springs Virginia Saratoga Springs New York and Glenwood Springs and Manitou Soda Springs Colorado belong in this group Among the foreign alkaline waters are those of Karlsbad and Marienbad

*Bitter waters* are those which contain magnesium sulfate and therefore have laxative qualities Apenta water and the water of Tate Spring Tennessee belong in this group

*Chalybeate* or *iron waters* are those which contain iron in medicinal quantities Springs of this type are numerous everywhere among which may be mentioned those at Sharon Springs and Saratoga Springs New York and Tunbridge Wells in England

*Calcareous waters* are those which contain the alkaline earths calcium and magnesium The springs at Waukesha Wisconsin Clifton Springs New York Bath England and Wildigen Austria are of this group

*Sulfur waters* are those which contain sulfides and occasionally chlorides They are numerous but their great popularity except for the hygienic and social features of the spa has gradually waned The spas of Santa Barbara California and of Hot Sulphur Springs and Glenwood Springs Colorado belong in this group Many of the more popular European spas are of this type among them Aix les Bains France Aix la Chapelle Germany and Baden Austria

*Arsenical waters* are those which contain arsenites and arsenates The Crocket Arsenic Lithia Springs in Virginia and the Harbin Hot Sulphur Springs of California are of this type

**Alcoholic Beverages** Alcohol is oxidized in the body and in small quantities may be used in metabolism to replace isodynamic quantities of carbohydrate or fat Atwater and Benedict[30] observed that a man at rest taking an ordinary diet of 2500 Calories or at work taking 3500 Calories burned 98 per cent of the 72 gm of alcohol (500 Calories) given him Notwithstanding its ready availability as a source of energy it can never be depended on however as the principal form of nourishment Lusk states that those who are accustomed to its use will oxidize a reasonable amount in seven and a half hours while those unaccustomed to its use require twice that time

Alcoholic beverages as a rule are taken for two purposes for their flavor and for the sense of well being which they give The only question of interest here is the use of alcohol as a food and as a food adjuvant There are times in the treatment of disease when alcoholic beverages are unquestionably of help In the feeding of elderly persons and those with debilitating disease they are of definite value Such beverages taken with the meal often improve appetite and digestion I have known nervous dyspepsia to be definitely cured and the patient s enjoyment of life enormously enhanced by two small drinks of whisky daily Alcohol will sometimes remove the inhibiting influences of worry anxiety and exhaustion and thus permit the person to relax and secure rest which otherwise perhaps would not be obtainable Rest both mental and physical is a therapeutic factor of far reaching importance It has been

argued that opium will do the same thing but this is not true In their beneficial influences and their ill effects opium and alcohol are in no wise comparable Alcoholic beverages properly used at the proper time may be of benefit The alcoholic content and food value of the various beverages are given in Table 139 in the Appendix

For additional details of foods, the reader is referred to Jacobs treatise[36]

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# 11

## The Normal Diet—Résumé

The normal person, guided by appetite and custom, if free to choose, can usually be trusted to select an adequate diet Unfortunately, freedom of choice may be restricted by economic limitations, the availability of foods, dietary prejudices, superstitions, or social attitudes which endow some foods with prestige values and which identify others as common and beneath the dignity of self respecting people Despite these and other limitations, it may be safely generalized that long established cultural patterns of diet are frequently adequate or as nearly so as can be attained by a given people without the benefit of basic changes in food production and distribution It is important to recognize that adequate nutrition may be accomplished by many dietary patterns

In order that a particular dietary pattern be nutritionally sound, it must meet (*a*) the fuel requirement, (*b*) the protein requirement, and (*c*) the need for minerals and vitamins In addition, the dietary must be acceptable to the individual, it must be economically feasible, must provide satiety and some roughage be digestible, and be free of harmful substances, such as pathogenic microorganisms or toxic products

Nutrient Allowances Detailed discussions in the preceding chapters have dealt with the requirements for energy, protein, minerals, vitamins, and other considerations For convenience, Table 55 presents the recommended daily dietary allowances of the Food and Nutrition Board of the National Research Council These allowances summarize an estimate of nutrient intakes which is not only designed to meet the minimal requirements, but to provide for desired margins of safety which scientific judgment opines as sound These recommended allowances were formulated as "objectives toward which to aim in planning practical dietaries" The recommended allowances can be attained with a good variety of commonly available foods which will also provide nutrients for which requirements are less well known It is fair to state that a diet which supplies nutrients meeting these allowances provides the individual with maximal nutritional health insurance On the other hand, a dietary which fails by a considerable margin to supply nutrients at the recommended level is suspect and, if consumed over a considerable period of time, could not be assumed to protect all persons against possible health impairments

DIET IN HEALTH

# 11

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In order that a particular dietary pattern be nutritionally sound, it must meet (*a*) the fuel requirement, (*b*) the protein requirement, and (*c*) the need for minerals and vitamins. In addition, the dietary must be acceptable to the individual, it must be economically feasible, must provide satiety and some roughage, be digestible, and be free of harmful substances, such as pathogenic microorganisms or toxic products.

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**Table 55. Recommended Daily Dietary Allowances**

**Revised 1948**

**(Food and Nutrition Board National Research Council)**

| | Calories[1] | Protein (gm.) | Calcium (gm.) | Iron (mg.) | Vitamin A[2] (I.U.) | Thiamine[3] (mg.) | Riboflavin[3] (mg.) | Niacin (Nicotinic acid)[3] (mg.) | Ascorbic acid (mg.) | Vitamin D (I.U.) |
|---|---|---|---|---|---|---|---|---|---|---|
| Man (154 lb., 70 kg.) | | | | | | | | | | |
| Sedentary | 2400 | 70 | 1.0 | 12 | 5000 | 1.2 | 1.8 | 12 | 75 | [5] |
| Physically active | 3000 | 70 | 1.0 | 12[4] | 5000 | 1.5 | 1.8 | 15 | 75 | [5] |
| With heavy work | 4500 | 70 | 1.0 | 12[4] | 5000 | 1.8 | 1.8 | 18 | 75 | [5] |
| Woman (123 lb., 56 kg.) | | | | | | | | | | |
| Sedentary | 2000 | 60 | 1.0 | 12 | 5000 | 1.0 | 1.5 | 10 | 70 | [5] |
| Moderately active | 2400 | 60 | 1.0 | 12 | 5000 | 1.2 | 1.5 | 12 | 70 | [5] |
| Very active | 3000 | 60 | 1.0 | 12 | 5000 | 1.5 | 1.5 | 15 | 70 | [5] |
| Pregnancy (latter half) | 2400[6] | 85 | 1.5 | 15 | 6000 | 1.5 | 2.5 | 15 | 100 | 400 |
| Lactation | 3000 | 100 | 2.0 | 15 | 8000 | 1.5 | 3.0 | 15 | 150 | 400 |
| Children up to 12 yrs.[7] | | | | | | | | | | |
| Under 1 yr.[8] | 110/2.2 lb. (1 kg.) | 3.5/2.2 lb. (1 kg.) | 1.0 | 6 | 1500 | 0.4 | 0.6 | 4 | 30 | 400 |
| 1–3 yrs. (27 lb., 12 kg.) | 1200 | 40 | 1.0 | 7 | 2000 | 0.6 | 0.9 | 6 | 35 | 400 |
| 4–6 yrs. (42 lb., 19 kg.) | 1600 | 50 | 1.0 | 8 | 2500 | 0.8 | 1.2 | 8 | 50 | 400 |
| 7–9 yrs. (58 lb., 26 kg.) | 2000 | 60 | 1.0 | 10 | 3500 | 1.0 | 1.5 | 10 | 60 | 400 |
| 10–12 yrs. (78 lb., 35 kg.) | 2500 | 70 | 1.2 | 12 | 4500 | 1.2 | 1.8 | 12 | 75 | 400 |
| Children over 12 yrs.[7] | | | | | | | | | | |
| Girls, 13–15 yrs. (108 lb., 49 kg.) | 2600 | 80 | 1.3 | 15 | 5000 | 1.3 | 2.0 | 13 | 80 | 400 |
| 16–20 yrs. (122 lb., 55 kg.) | 2400 | 75 | 1.0 | 15 | 5000 | 1.2 | 1.8 | 12 | 80 | 400 |
| Boys, 13–15 yrs. (108 lb., 49 kg.) | 3200 | 85 | 1.4 | 15 | 5000 | 1.5 | 2.0 | 15 | 90 | 400 |
| 16–20 yrs. (141 lb., 64 kg.) | 3800 | 100 | 1.4 | 15 | 6000 | 1.7 | 2.5 | 17 | 100 | 400 |

be adjusted up or down to meet specific needs The calorie
-fore not applicable to all individuals, but rather represent
r calorie allowance is *that which over* an extended period
r rate of growth at the level most conducive to well-being
on the relative amounts of vitamin A and carotene The
based on the premise that approximately two-thirds of the
age diet in this country is contributed by carotene and that
n half the value of vitamin A

nant and lactating women) receiving diets supplying 2000
ucing diets, the allowances *of thiamine* and niacin may be
vely The fact that figures are given for different calorie
in does not imply that we can estimate the requirement of
ries, but they are added merely for simplicity of calculation
oflavin allowances are based on body weight rather than
ers of the B complex also are required, though no values can
g adequate thiamine, riboflavin, and niacin will tend to
aining *B* vitamins

the male adult needs relatively little iron The need will
ne diet is satisfactory in other respects

ital vitamin D by vigorous adults leading a normal life seems
ns working at night and for nuns and others whose habits
ght, as well as for elderly persons, the ingestion of small
sirable

of pregnancy the *calorie allowance* should increase to
above the preceding level The value of 2400 calories repre-
gnant sedentary women

are based on the needs for the middle year in each group
*moderate activity* and for average weight at the middle year

ease from month to month with size and activity The
roximately 6 to 8 *months* *The dietary requirements* for
as protein and calcium are less if derived largely from

Further recommendations

**Fat.** *There is available little information concerning the human requirement for* fat Fat allowances must be based at present more on food habits than on physiologic requirements While a requirement for certain unsaturated *fatty acids (the linoleic* and arachidonic acids of natural fats) has been amply demonstrated with experimental animals, the human needs for these fatty acids is not known In spite of the paucity of *information on this subject,* several factors make it desirable (1) that fat be included in the diet to the extent of at least 20 to 25 per cent of the total calories and (2) that the fat intake include essential unsaturated fatty acids to the extent of at least 1 per cent of the total calories *At higher levels of energy expenditure, e g , for a very active* person consuming 4500 calories and for children and *for adolescent persons,* it is desirable that 30 to 35 per cent of the total calories be derived from fat *Since foodstuffs* such as meat, milk, cheese, nuts, etc , contribute fat to the diet, it is necessary to use separated or "visible" fats such as butter, oleomargarine, lard, or shortenings to supply only one third to one-half *the amounts indicated*

**Water.** A suitable allowance of water for adults is 2 5 liters daily in most instances An ordinary standard for diverse persons is 1 milliliter for each calorie of food Most of this quantity is *contained in prepared* foods At work or in hot weather, requirements may reach 5 to 13 liters daily Water should be allowed *ad libitum,* since sensations of thirst usually serve as adequate guides to intake except for infants and sick persons.

**Salt.** *The needs for salt* and for water are closely interrelated A liberal allowance of sodium chloride for the adult is 5 gm daily, except for some persons who sweat *profusely* *The average normal intake* of salt is 10 to 15 gm daily, an amount which meets the salt requirements for a water intake up to 4 liters daily When sweating is excessive, one additional gram of salt should be *consumed for* each liter of water in excess of 4 liters daily With heavy work or in hot climates 20 to 30 gm daily may be consumed with meals and in drinking water Even then, most persons do not need more salt *than usually occurs in* prepared foods It has been shown that after acclimatization, persons produce sweat that contains only about 0 5 gm to the liter in contrast with a content of 2 to 3 gm for sweat of the unacclimatized person Consequently, after acclimatization, need *for increase of salt beyond that of ordinary* food disappears

**Iodine** The requirement for iodine is small, probably about *0 002* to *0 004 mg.* daily for each kilogram of body weight, or a total of 0 15 to 0 30 mg daily for the adult This need is met by the regular use of iodized salt, its use is especially important in *adolescence* and *pregnancy*

**Phosphorus** Available evidence indicates that the phosphorus allowances should be at least equal to those for calcium in the diets of children and of women during the *latter part of pregnancy and during lactation* For other adults the phosphorus allowances should be approximately 1 5 times those for calcium In general it is safe to assume that if the calcium and protein needs are met through common foods, the phosphorus requirement also will be covered, because the common foods richest in calcium and protein are also the best sources of phosphorus

**Copper.** The requirement for copper for adults is about 1 to 2 mg daily. Infants and children require approximately 0 05 mg for each kilogram of body weight The requirement for copper is approximately one-tenth *that for iron* A good diet normally will supply sufficient copper

**Vitamin K** The requirement for vitamin K usually is satisfied by any good diet except for the infant in utero and *for the first few days* after birth Supplemental vitamin K is recommended during the last month of pregnancy When it has not been given in this manner, it is recommended for the mother preceding delivery or for the *baby immediately after* birth

**Folic Acid** Evidence for recognizing folic acid (pteroylglutamic acid, vitamin Bc, L casei *factor or vitamin M) as an essential human nutrient is presented* in the text. The quantitative requirement cannot be closely estimated from evidence now available.

Numerous other dietary standards have been proposed by other bodies with somewhat different backgrounds or uses in mind Of these one of the most carefully designed is that prepared by the Canadian Council on Nutrition [1] These are reproduced in the Appendix

Under ordinary circumstances it is not necessary that a person's requirement be estimated to a nicety Indeed, Du Bois[2] pointed out that when we guess a dozen different factors and then with great accuracy add these together we merely make a show of precision It is doubtful whether under ordinary circumstances a man's caloric requirement can be estimated closer than 400 or 500 Calories per day or his protein requirement in steps smaller than 15 or 20 gm

**Nutrient Calculations** It is possible to test the adequacy of any given dietary in relation to a particular standard through calculations of the nutrients supplied by the diet as indicated by tables of food composition Such tables of food composition are provided in the Appendix (q v)

The validity of the estimates of nutrient intakes derived from use of such tables has been the subject of much discussion and some investigation Such calculations provide a useful, if not precise, estimate of the nutritive value of diets [3,4]

The need for a method to assess the nutritional adequacy of hospital diets is illustrated by studies discussed in a review in Nutrition Reviews [5] It was found, for example, that the ascorbic acid content of seven progressive Sippy diets ranged from 1 0 to 11 0 mg per day and the niacin content from 1 0 to 3 5 mg per day Indeed, the regular diet served in the hospital where this study was made was low in its content of ascorbic acid, thiamine, riboflavin, and niacin Such defects in planning of both normal and therapeutic diets can and should be avoided by the proper appraisal of the nutrients supplied by the dietary regimen

After this discussion of dietary standards and of numerically expressed food values it is necessary to say a word of warning against slavish adherence to ironclad rules Numerical standards should be governed by circumstances and must change accordingly *Figures are mere guides, and a thorough understanding of the principles of nutrition, together with good judgment, should govern the use of dietary standards*

**Food Groups** There are throughout the world many different dietary patterns which provide adequate supplies of nutrients Within the United States and Canada the most feasible widely acceptable pattern is that described by the grouping of foods into some seven basic food groups These food groups are designed on the basis of similar nutrient content of the members of each group Because of the similar nutrient content of foods within the groups it is practical to plan a dietary which will satisfy a particular dietary allowance by merely defining the number of servings from each of the seven groups which are to be taken daily The following list identifies these groups indicates the recommended number of servings per day to be taken from each group to provide an adequate diet, and, finally, enumerates the most common foods included in each group

Table 56 The Basic Seven Food Groups

| Group I | Recommended Number of Servings per Day | Foods | |
|---|---|---|---|
| Green leafy and yellow vegetables | 1 or more | Green leafy | Yellow |
| | | Asparagus | Carrots |
| | | Broccoli | Sweet potatoes |
| | | Beet tops | Rutabagas |
| | | Brussels sprouts | Yellow turnips |
| | | Green beans | Squash |
| | | Chard | |
| | | Spinach | |
| | | Endive | |
| | | Dandelion Greens | |
| | | Lettuce | |
| | | Peas | |
| | | Watercress | |
| **Group II** | | | |
| Citrus fruits tomatoes raw cabbage | 1 or more | Oranges | Tomato juice |
| | | Orange juice | Tangerines |
| | | Grapefruit | Tangerine juice |
| | | Grapefruit juice | Blended juices |
| | | Tomatoes | Raw cabbage |
| **Group III** | | | |
| Potatoes and other vegetables and fruits | 2 or more | Potatoes | Apples |
| | | Beets | Bananas |
| | | Cauliflower | Berries |
| | | Celery | Cherries |
| | | Eggplant | Peaches |
| | | Lima beans | Pears |
| | | Onions | Pineapple |
| | | Parsnips | Fresh or dried |
| | | Radishes | Apricots |
| | | Turnips | Dates |
| | | Wax beans | Figs |
| | | Rhubarb | Prunes |
| | | | Raisins |
| **Group IV** | | | |
| Milk cheese ice cream | Children—3-4 cups<br>Adults—2 or more cups | Milk | Cheese—all kinds |
| | | Fresh whole | Ice cream |
| | | Fresh skimmed | Milk sherbets |
| | | Evaporated | |
| | | Dried whole | |
| | | Dried skimmed | |
| | | Buttermilk | |
| **Group V** | | | |
| Meat poultry fish eggs dried peas beans nuts | 2 or more | Beef | Chicken |
| | | Lamb | Duck |
| | | Veal | Turkey |
| | | Pork | Goose |
| | | Rabbit | |
| | | Organ and variety meats | |
| | | Liver | |
| | | Heart | |
| | | Tongue and all other edible organs | |

Table 56 The Basic Seven Food Groups (*Continued*)

| Group V (*continued*) | Recommended Number of Servings per Day | Foods | |
|---|---|---|---|
| | | Sausage luncheon meats<br>Fish and seafood<br>All edible wild game<br>Eggs<br>Dried beans and peas—all varieties<br>Lentils<br>Soy beans<br>Nuts—including butters and spreads | |
| **Group VI** | | | |
| Bread flour cereals (whole grain enriched or restored) | Daily | Whole grain<br>Oatmeal<br>Cornmeal<br>Whole wheat flour<br>Rye<br>Other cereals and starches<br>Breads<br>Breakfast foods<br>Macaroni<br>Noodles<br>Thickening agents<br>Cornstarch<br>Tapioca | <br><br><br><br><br><br>Spaghetti<br>Crackers<br>Rice |
| **Group VII** | | | |
| Butter and fortified margarine | Daily | Butter<br>Oleomargarine (colored or uncolored—if fortified) | |
| Additional foods | Enough daily to supply caloric value and to make meals palatable and satisfying | Sugar<br>Brown<br>White | Honey<br>Molasses<br>Jellies jams and marmalades<br>Desserts |

**Daily Menu Pattern** The daily menu pattern will be influenced by the economic factor, national food patterns food preferences of a locale individual food preferences, availability of foods and the like

Within the framework of the national food pattern of the United States and Canada, the day s meals should include representatives of the basic seven groups as follows

| | |
|---|---|
| Green leafy and yellow vegetables (Group I) | 1 or more servings (one should be raw) |
| Citrus fruits tomatoes or raw cabbage (Group II) | 1 or more servings |
| Potatoes and other vegetables and fruits (Group III) | 2 or more servings |
| Milk cheese ice cream (Group IV) | 2 4 cups for children<br>2 cups or more for adults |
| Meat poultry fish eggs dried peas beans and nuts (Group V) | 2 or more servings |
| Bread flour cereals (Group VI) | Daily |
| Butter and/or fortified margarine (Group VII) | Daily |

Additional foods to supply caloric value and to make meals palatable

The following food pattern is offered as a guide for planning

Breakfast

Fruit
Egg (at least 3 each week)
Bacon or sausage (if desired)
Toast cereal (one cup)
Butter or oleomargarine
Coffee for adults
Milk or cocoa for children
Jam jelly honey

Lunch (if dinner is served at night if main meal is at lunch use dinner menu)

Casserole dish thick soup stew
Hot vegetable
Salad
Bread and butter or oleomargarine
Fruit or fruit dessert
Milk

Dinner

First course—if desired
Meat fish poultry egg
Potato or substitute
Vegetable
Salad
Dessert
Bread and butter
Coffee tea for adults
Milk for children

Some persons adopt a meal pattern which differs from the conventional three meals a day More frequent feedings may be needed or desired This is a matter of personal taste The division of food among meals is immaterial as long as all the daily requirements are supplied It is advisable, however to include breakfast since this meal as its name signifies provides sustenance following a considerable period of fasting It has been demonstrated repeatedly that failure to partake of breakfast results in decreased work efficiency in the later hours of the morning [18]

**Menu** The following three menus are examples of adequate normal diets at three cost levels These particular menus illustrate well how relatively simple variations in planning may convert a low, medium or high cost menu to another cost level

**Table 57 Illustrative Menu for a Normal Diet**

| | *Low Cost* | *Medium Cost* | *High Cost* |
|---|---|---|---|
| Breakfast | Stewed prunes | Stewed prunes | Orange juice |
| | Fortified farina | Fortified farina | Fortified farina |
| | Brown sugar | Brown sugar | Brown sugar |
| | Dry milk solids | Whole milk | Whole milk |
| | One soft cooked egg | One soft cooked egg | One soft cooked egg |
| | Enriched or whole wheat toast | Whole wheat toast | Whole wheat toast |
| | | | Bacon or sausage |
| | Margarine | Margarine | Butter and jelly |
| | Coffee with sugar and dry milk solids | Coffee with sugar and cream | Coffee with sugar and cream |

Table 57 Illustrative Menu for a Normal Diet *(Continued)*

| | *Low Cost* | *Medium Cost* | *High Cost* |
|---|---|---|---|
| Dinner | | | Fruit juice with sherbet |
| | Macaroni and cheese | Macaroni and cheese | Chicken a la king on toast points |
| | Stewed tomatoes | *Stewed tomatoes* | *Baked tomato halves au gratin* |
| | Tossed greens with French dressing | Tossed greens with French dressing | Tossed greens with French dressing |
| | Whole wheat bread | Whole wheat bread | Whole wheat rolls |
| | Fortified margarine | Fortified margarine | Butter |
| | Fresh fruit cup | Fresh fruit cup | Honey dew melon with lime |
| | Dry milk solids | Milk | *Milk* |
| Supper | | | Consomme |
| | Vegetable meat loaf with gravy | *Swiss steak* | *Roast beef au jus* |
| | Mashed potatoes | Mashed potatoes | Mashed potatoes |
| | Buttered carrots | Parslied buttered carrots | Buttered broccoli |
| | Grapefruit sections and red apple salad | Grapefruit sections and red apple salad | Grapefruit and avocado salad |
| | Rice raisin pudding | Peach Betty with lemon sauce | Pineapple sherbet, brownies |
| | Biscuits | Biscuits with fortified margarine | Biscuits with butter |
| | *Beverage* | *Beverage* | Beverage |

**Therapeutic Diet** The basic principle which underlies the planning and use of a therapeutic diet is to regard any therapeutic diet as but a modification of the normal dietary or a control of the quantity of the normal dietary in such manner as to fulfill a particular need *Such a modification must be designed to preserve the nutrient composition of the normal diet and with a due consideration of economic factors*

### THE CHILD OF SCHOOL AGE

The nutritional needs of the child of school age for many reasons *demand special consideration His great activity requires* a disproportionately large caloric intake, his rapid growth calls for an abundance of good protein and of mineral salts, and his need for vitamins is even more imperative than that of the adult In determining these requirements two facts must be kept clearly in mind First, the child s ' normal standards ' are not fixed They vary widely and are represented as was emphasized by Washburn,[6] by broad zones rather than average lines The truth of this was demonstrated also by Macy and her associates [7] of the Children s Fund of Michigan, who found in the same group of *highly selected healthy children significant physiologic* variations from day to day, week to week and year to year Second, many children do *not get enough to eat* or may have exceedingly poor food selection patterns

Evidence of need for closer attention to the child s diet is abundant Witness the survey of school children of rural and urban communities

conducted by the Florida Board of Health in which it was observed that the incidence of nutritional deficiency and anemia was 'disconcertingly high [8] From Iowa comes somewhat similar testimony by Boyd,[9] who enumerates the following commonplace practices that carry with them great hazards of dietary inadequacy (1) breakfast small, poorly chosen, or omitted (2) lunch eaten away from home routinely (3) eating practices not supervised by an adult, (4) responsibility for choice of food left to the child, (5) limitation or prohibition of any of the 'caloric foods , (6) no inclusion of fish liver oil or its equivalent (7) failure to eat meat, eggs or equivalent foods daily, (8) failure to eat liberal servings of vegetables and fruits daily

To this list of hazards should be added the overindulgence by some children in foods and drinks such as candies and carbonated beverages, which are but sources of calories and make little contribution of other nutrients to the diet Especially pernicious is the expenditure of school lunch money for these products in lieu of more basic foods [10] and the resulting substitution of refined sources of calories for a more healthful food pattern

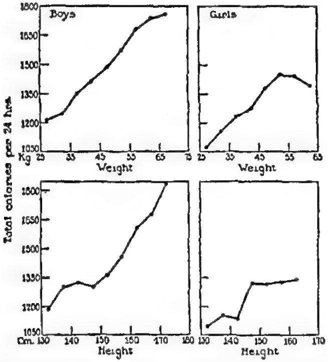


Fig 7 Heat production in total calories per day of boys and girls in relationship to the mean weight and height curves (Webster Harringson and Wright J Pediat Vol 19)

**Total Quantity of Food** The quantity of food required by the child is determined by his basal metabolism rate of growth and physical activities plus the dynamic action of the food and the losses in the excreta

The basal metabolism of children according to Talbot [11] can more accurately be based on height and weight than on surface area This

author finds that the latter method has not given for children the same satisfactory results that have been obtained for adults and after many years of study he writes that fewer mistakes are made in the case of children when there is adopted the standard of total calories for the weight supplemented by that of the total calories for the height (in other words the total calories for the expected weight ) Webster and his co workers[12] following their studies of adolescent boys and girls, are inclined to place greater reliance for boys on the standards of Bierring and for girls on those of Kestner and Knipping The figures of Talbot will be found in Tables 58 and 59, and those of Webster and his associates in Figure 7

The ratio of growth, as evidenced by gain in stature and weight, increases gradually from the tenth year This increase is such that in the girl's thirteenth year and the boy's sixteenth year the ratio of gain is double that seen in the early years of school life The relative heat production was found by Webster and his associates to fall gradually between the ages of ten and sixteen years this fall being most marked between the ages of eleven and twelve years

The amount of food which must be added in order to take care of the child s great activity is difficult to determine accurately Benedict and Talbot express the opinion that this increase in caloric output above the basal for children in the schoolroom is 75 per cent for boys and 50 per

Table 58 Standard Total Calories for Weight—Girls and Boys (Talbot[11])

| Weight Kg | Total Calories per 24 Hours Girls* | Boys | Weight Kg | Total Calories per 24 Hours Girls* | Boys |
|---|---|---|---|---|---|
| 3 0 | 136 | 150 | 36 0 | 1 173 | 1,270 |
| 4 0 | 205 | 210 | 38 0 | 1 207 | 1 305 |
| ʳ 0 | 274 | 270 | 40 0 | 1 241 | 1,340 |
| 6 0 | 336 | 330 | 42 0 | 1 274 | 1 370 |
| 7 0 | 395 | 390 | 44 0 | 1 306 | 1 400 |
| 8 0 | 448 | 445 | 46 0 | 1 338 | 1 430 |
| 9 0 | 496 | 495 | 48 0 | 1 369 | 1 460 |
| 10 0 | 541 | 545 | 50 0 | 1 399 | 1 485 |
| 11 0 | 582 | 590 | 52 0 | 1 429 | 1 50ɔ |
| 12 0 | 620 | 6°5 | 54 0 | 1 458 | 1,555 |
| 13 0 | 6ʳ5 | 66ɔ | 56 0 | 1 487 | 1 580 |
| 14 0 | 687 | 700 | 58 0 | 1 516 | 1,600 |
| 15 0 | 718 | 72ɔ | 60 0 | 1,544 | 1 630 |
| 16 0 | 747 | 7ɔ0 | 62 0 | 1 57° | 1 660 |
| 17 0 | 775 | 780 | 64 0 | 1 599 | 1 690 |
| 18 0 | 802 | 810 | 66 0 | 1 626 | 1 725 |
| 19 0 | 827 | 840 | 68 0 | 1 653 | 1 765 |
| 20 0 | 852 | 870 | 70 0 | 1,679 | 1 78ɔ |
| 2° 0 | 898 | 910 | 72 0 | 1 70ɔ | 1 815 |
| 24 0 | 942 | 980 | 74 0 | 1 731 | 1 845 |
| 26 0 | 984 | 1 070 | 76 0 | 1 756 | 1 870 |
| 28 0 | 1 02ɔ | 1 100 | 78 0 | 1 781 | 1 900 |
| 30 0 | 1 063 | 1 140 | 80 0 | 1 805 | |
| 32 0 | 1 101 | 1 190 | 82 0 | 1 830 | |
| 34 0 | 1 137 | 1,230 | 84 0 | 1 855 | 2 000 |

* From Talbot Wilson and Worcester

**Table 59 Standard Total Calories for Height (or Total Calories for the Expected Weight)*—Girls and Boys (Talbot[11])**

| Height Cm | Total Calories per 24 Hours Girls† | Boys | Height Cm | Total Calories per 24 Hours Girls† | Boys |
|---|---|---|---|---|---|
| 48 | 134 | | | | |
| 50 | 159 | | 92 | 681 | 725 |
| 51 | | 160 | 94 | 695 | 740 |
| 52 | 186 | 175 | 96 | 709 | 755 |
| 54 | 214 | 200 | 98 | 722 | 765 |
| 56 | 246 | 225 | 100 | 735 | 785 |
| 58 | 278 | 260 | 105 | 770 | 805 |
| 60 | 309 | 300 | 110 | 807 | 830 |
| 62 | 341 | 315 | 115 | 846 | 875 |
| 64 | 373 | 360 | 120 | 894 | 935 |
| 66 | 404 | 390 | 125 | 942 | 990 |
| 68 | 433 | 420 | 130 | 987 | 1 045 |
| 70 | 462 | 450 | 135 | 1 057 | 1 105 |
| 72 | 489 | 480 | 140 | 1 130 | 1 165 |
| 74 | 515 | 510 | 145 | 1,208 | 1 220 |
| 76 | 539 | 533 | 150 | 1,294 | 1,290 |
| 78 | 560 | 565 | 155 | 1 386 | 1 380 |
| 80 | 581 | 590 | 160 | 1 477 | 1 480 |
| 82 | 601 | 612 | 165 | 1,544 | 1,570 |
| 84 | 619 | 635 | 170 | 1,584 | 1 655 |
| 86 | 636 | 660 | 175 | 1 596 | 1 720 |
| 88 | 652 | 685 | 180 | 1 600 | 1 800 |
| 90 | 666 | 705 | 190 | | 1 900 |

* Since the highest standard is based on a normal weight this can also be called expected weight

† From Talbot Wilson and Worcester

cent for girls Lusk estimated that the active child requires about double the food of the quiet child This estimate is perhaps low for the most active type, say the boy of twelve years, for at his age he often requires more food than his father For instance, Gephart[13] observed at St Paul's School that many boys fourteen years of age took over 5000 calories daily, this probably represents the peak of activity and the maximum need for food

The recommended allowance of nutrients for various age groups is presented in Table 55 These nutrient allowances should be provided by a dietary pattern of varied foods as is discussed in the section on food patterns Children especially adolescent groups are peculiarly susceptible to social attitudes toward foods and every effort should be made to develop the acceptance of those foods which are basic to an adequate dietary

**Arrangement of the Diet** The most important food for the child is milk it should form the basis of his diet This warrants repeated emphasis Too often children are allowed to become indifferent to milk or to acquire an actual distaste for it and to cease drinking it This means well nigh irreparable loss to the child Milk may be taken in part as cocoa or it may be made into custards and similar dishes but in order to secure the requisite quantity at least some of it must be taken directly as milk When fresh milk cannot be obtained, the dried article is

entirely suitable, provided it is supplemented by orange juice A quart of milk a day for each child should be the aim

Cereals are excellent, especially if taken with milk Oatmeal, rolled oats, and other cooked whole grain cereals are good Those cereals which must be cooked are as a rule preferable to the more expensive flaked and puffed grains Cereals which retain a large part of the whole grain such as whole wheat or oatmeal, are to be preferred because of their greater vitamin and mineral content Well made bread which is light and porous is digestible hot or cold

Eggs are valuable food for the child They supply proteins of high biologic value, easily digested fats, iron and fat soluble vitamins They should be simply prepared—soft boiled poached or shirred rather than fried One egg a day is desirable

Meats should be a regular item in the diet Meats which are simply prepared are to be preferred to the more complex croquettes and meat salads Stews and sandwiches made from finely ground meats are especially acceptable to children if they are not too highly seasoned

The eating of green vegetables should be encouraged The leafy vegetables, such as spinach, lettuce and cauliflower, are to be preferred Peas beans, onions, squash and asparagus are also of value, tomatoes are of especial value Vegetables should be given in the water in which they are cooked, since this contains valuable mineral salts and vitamins

Fruit, either raw or cooked, should be eaten each day, but raw fruits should be fully ripe Oranges are always desirable Ripe bananas which have begun to 'spot' are valuable They may be given even to very young children Cooked fruits, preferably stewed, are excellent this applies to dried as well as to fresh fruits Baked or stewed apples and stewed prunes are especially good

Simple desserts and preserved fruits are not harmful if taken in moderation and at the right time They should be eaten always at the end of the meal, for sweets taken between meals destroy the appetite and may interfere with digestion Pies and other pastries are sometimes indigestible because they are greasy and heavy If well made and crisp they need not be denied the child provided they are eaten in moderation

The child obtains his fat largely in the form of butter, cream and egg yolk, supplemented by gravy taken with bread, rice or potatoes

Simple foods are best, complex highly seasoned dishes should be avoided Articles which unduly stimulate the appetite are both unnecessary and harmful they tend to destroy the natural tastes Salt taken in small amounts often enhances the flavor of food but in excess destroys it the desire for large amounts of salt is artificial and should be discouraged The drinking of water at meals has no disadvantage except that it may prevent the child s taking his full quota of milk Sometimes it is of advantage to withhold water at meal times in order to induce him to take more milk

Variety in diet should be insisted on The child should be taught to eat of everything wholesome which comes to the table it is a mistake which later in life becomes a real handicap, to permit a child to develop peculiarities of taste

Regularity of meals and lack of haste are important. The child should learn to eat with reasonable slowness and should never be permitted to hurry through his meals. Pleasant conversation and good humor at the table are as important for him as for the adult.

**Body Measurements.** One simple and useful measure of nutritional status is the growth pattern of the child. Table 60 shows the spread of height, weight and other measurements among children of five to thirteen and a half years, as observed by Stuart and Meredith.[14] These authors call attention to the fact that a measurement can be interpreted best when related to other figures depicting over all distribution for that measurement. The percentile column in which the figure finds itself indicates its relative position with respect to that measurement for the age and sex of all children. For example, the fact that a boy of six years weighs 45 pounds is of significance only when it is known that 75 per *cent of boys of that age weigh more than this. It means more, too, if it* is known that this boy is not short or of slender build and that for his age he is up to the average in chest circumference and hip width. A comparison of these figures with those of the boy's earlier years is also helpful.

**Table 60. Selected Percentiles for Five Body Measurements. Ages 5 to 13½ years**
**(Stuart and Meredith[14])**

(The basic data were collected 1930-1945 on Iowa City children of northwest European ancestry attending University of Iowa experimental schools.)

| Boys Percentiles 10 | 25 | 50 | 75 | 90 | | Girls Percentiles 10 | 25 | 50 | 75 | 90 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | **5 Years** | | | | | |
| 36.6 | 39.6 | 42.8 | 46.5 | 49.7 | Weight | 36.1 | 38.6 | 41.4 | 44.2 | 48.2 |
| 105.3 | 109.3 | 111.3 | 114.2 | 116.7 | Height | 105.0 | 107.2 | 109.7 | 112.9 | 115.4 |
| 17.0 | 17.6 | 18.3 | 18.9 | 19.6 | Hip Width | 17.0 | 17.4 | 18.0 | 18.7 | 19.4 |
| 51.6 | 52.8 | 54.5 | 56.2 | 57.5 | Chest Circ. | 50.2 | 51.4 | 52.9 | 54.6 | 56.5 |
| 21.0 | 21.7 | 22.6 | 23.6 | 24.6 | Leg Girth | 21.1 | 21.8 | 22.8 | 23.8 | 24.7 |
| | | | | | **5½ Years** | | | | | |
| 38.8 | 42.0 | 45.6 | 49.3 | 53.1 | Weight | 38.0 | 40.8 | 44.0 | 47.2 | 51.2 |
| 108.3 | 111.2 | 114.4 | 117.5 | 120.1 | Height | 107.8 | 110.2 | 112.8 | 116.1 | 118.9 |
| 17.4 | 18.0 | 18.7 | 19.4 | 20.1 | Hip Width | 17.4 | 17.8 | 18.4 | 19.1 | 20.0 |
| 52.4 | 53.6 | 55.3 | 57.1 | 58.5 | Chest Circ. | 50.9 | 52.2 | 53.7 | 55.5 | 57.4 |
| 21.4 | 22.2 | 23.1 | 24.1 | 25.2 | Leg Girth | 21.5 | 22.3 | 23.3 | 24.3 | 25.3 |
| | | | | | **6 Years** | | | | | |
| 40.9 | 44.4 | 48.3 | 52.1 | 56.4 | Weight | 39.9 | 42.9 | 46.5 | 50.2 | 54.2 |
| 111.2 | 114.1 | 117.5 | 120.8 | 123.5 | Height | 110.6 | 113.2 | 115.9 | 119.3 | 122.3 |
| 17.7 | 18.4 | 19.1 | 19.8 | 20.5 | Hip Width | 17.7 | 18.2 | 18.8 | 19.5 | 20.5 |
| 53.2 | 54.4 | 56.1 | 57.9 | 59.5 | Chest Circ. | 51.5 | 52.9 | 54.5 | 56.3 | 58.2 |
| 21.8 | 22.6 | 23.6 | 24.6 | 25.7 | Leg Girth | 21.9 | 22.7 | 23.8 | 24.8 | 25.8 |
| | | | | | **6½ Years** | | | | | |
| 43.4 | 47.1 | 51.2 | 55.4 | 60.4 | Weight | 42.2 | 45.5 | 49.4 | 53.3 | 57.7 |
| 114.1 | 117.2 | 120.8 | 124.2 | 127.0 | Height | 113.7 | 116.2 | 119.1 | 122.6 | 125.6 |
| 18.1 | 18.8 | 19.5 | 20.2 | 21.0 | Hip Width | 18.1 | 18.6 | 19.2 | 20.0 | 21.1 |
| 54.1 | 55.3 | 57.0 | 58.9 | 60.6 | Chest Circ. | 52.2 | 53.7 | 55.3 | 57.2 | 59.2 |
| 22.2 | 23.1 | 24.1 | 25.2 | 26.3 | Leg Girth | 22.3 | 23.2 | 24.3 | 25.4 | 26.4 |

**Table 60 Selected Percentiles for Five Body Measurements Ages 5 to 13½ Years (Continued)**

| Boys Percentiles 10 | 25 | 50 | 75 | 90 | | Girls Percentiles 10 | 25 | 50 | 75 | 90 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | **7 Years** | | | | | |
| 45.8 | 49.7 | 54.1 | 58.7 | 64.4 | Weight | 41.5 | 48.1 | 52.2 | 56.3 | 61.2 |
| 116.9 | 120.3 | 124.1 | 127.6 | 130.5 | Height | 116.8 | 119.2 | 122.3 | 125.9 | 128.9 |
| 18.5 | 19.2 | 19.9 | 20.6 | 21.4 | Hip Width | 18.4 | 18.9 | 19.6 | 20.4 | 21.6 |
| 54.9 | 56.1 | 57.8 | 59.8 | 61.6 | Chest Circ. | 52.8 | 54.4 | 56.1 | 58.0 | 60.1 |
| 22.6 | 23.5 | 24.6 | 25.7 | 26.9 | Leg Girth | 22.7 | 23.7 | 24.8 | 25.9 | 27.0 |
| | | | | | **7½ Years** | | | | | |
| 48.5 | 52.6 | 57.1 | 62.1 | 68.7 | Weight | 46.6 | 50.6 | 55.2 | 59.8 | 65.6 |
| 120.0 | 123.5 | 127.1 | 130.9 | 133.9 | Height | 119.5 | 122.0 | 125.2 | 128.8 | 131.8 |
| 18.9 | 19.6 | 20.3 | 21.0 | 21.9 | Hip Width | 18.8 | 19.3 | 20.1 | 20.9 | 22.1 |
| 55.8 | 57.1 | 58.8 | 61.0 | 62.9 | Chest Circ. | 53.5 | 55.1 | 57.0 | 59.0 | 61.2 |
| 23.1 | 24.1 | 25.2 | 26.3 | 27.6 | Leg Girth | 23.1 | 24.2 | 25.3 | 26.4 | 27.7 |
| | | | | | **8 Years** | | | | | |
| 51.2 | 55.5 | 60.1 | 65.5 | 73.0 | Weight | 48.6 | 53.1 | 58.1 | 63.3 | 69.9 |
| 123.1 | 126.6 | 130.0 | 134.2 | 137.3 | Height | 122.1 | 124.8 | 128.0 | 131.6 | 134.6 |
| 19.2 | 19.9 | 20.7 | 21.4 | 22.3 | Hip Width | 19.1 | 19.7 | 20.5 | 21.3 | 22.6 |
| 56.7 | 58.0 | 59.8 | 62.1 | 64.1 | Chest Circ. | 54.2 | 55.8 | 57.8 | 59.9 | 62.3 |
| 23.0 | 24.6 | 25.7 | 26.3 | 28.2 | Leg Girth | 23.5 | 24.6 | 25.8 | 26.9 | 28.3 |
| | | | | | **8½ Years** | | | | | |
| 53.8 | 58.3 | 63.1 | 68.9 | 77.0 | Weight | 50.6 | 55.5 | 61.0 | 66.9 | 74.5 |
| 125.7 | 129.1 | 132.8 | 137.0 | 140.0 | Height | 124.6 | 127.3 | 130.5 | 134.4 | 137.5 |
| 19.6 | 20.3 | 21.1 | 21.8 | 22.7 | Hip Width | 19.4 | 20.1 | 20.9 | 21.8 | 23.1 |
| 57.6 | 59.0 | 60.8 | 63.3 | 65.4 | Chest Circ. | 54.9 | 56.5 | 58.7 | 60.9 | 63.5 |
| 24.1 | 25.1 | 26.3 | 27.4 | 28.9 | Leg Girth | 23.9 | 25.0 | 26.3 | 27.5 | 28.9 |
| | | | | | **9 Years** | | | | | |
| 56.3 | 61.1 | 66.0 | 72.3 | 81.0 | Weight | 52.6 | 57.9 | 63.8 | 70.5 | 79.1 |
| 128.3 | 131.6 | 135.5 | 139.8 | 142.6 | Height | 127.0 | 129.7 | 132.9 | 137.1 | 140.4 |
| 19.9 | 20.6 | 21.4 | 22.2 | 23.0 | Hip Width | 19.7 | 20.5 | 21.3 | 22.2 | 23.5 |
| 58.4 | 59.9 | 61.8 | 64.4 | 66.7 | Chest Circ. | 55.5 | 57.2 | 59.6 | 61.9 | 64.7 |
| 24.5 | 25.6 | 26.8 | 28.0 | 29.5 | Leg Girth | 24.2 | 25.4 | 26.8 | 28.1 | 29.5 |
| | | | | | **9½ Years** | | | | | |
| 58.7 | 63.7 | 69.0 | 76.0 | 85.5 | Weight | 54.9 | 60.4 | 67.1 | 74.8 | 84.4 |
| 130.6 | 134.0 | 137.9 | 142.1 | 145.1 | Height | 129.4 | 132.2 | 135.8 | 139.9 | 143.2 |
| 20.2 | 21.0 | 21.7 | 22.6 | 23.5 | Hip Width | 20.1 | 20.9 | 21.8 | 22.8 | 24.1 |
| 59.3 | 60.9 | 62.9 | 65.5 | 68.1 | Chest Circ. | 56.2 | 58.0 | 60.5 | 63.2 | 66.1 |
| 24.9 | 26.0 | 27.3 | 28.5 | 30.1 | Leg Girth | 24.7 | 25.9 | 27.3 | 28.6 | 30.2 |
| | | | | | **10 Years** | | | | | |
| 61.1 | 66.3 | 71.9 | 79.6 | 89.9 | Weight | 57.1 | 62.8 | 70.3 | 79.1 | 89.7 |
| 132.8 | 136.3 | 140.3 | 144.4 | 147.5 | Height | 131.7 | 134.6 | 138.6 | 142.6 | 146.0 |
| 20.4 | 21.3 | 22.0 | 22.9 | 23.9 | Hip Width | 20.5 | 21.2 | 22.2 | 23.3 | 24.6 |
| 60.1 | 61.8 | 63.9 | 66.6 | 69.4 | Chest Circ. | 56.9 | 58.7 | 61.4 | 67.4 | 67.4 |
| 25.3 | 26.4 | 27.7 | 29.0 | 30.7 | Leg Girth | 25.1 | 26.3 | 27.7 | 29.1 | 30.9 |
| | | | | | **10½ Years** | | | | | |
| 63.7 | 69.0 | 74.8 | 83.4 | 94.6 | Weight | 59.9 | 66.4 | 74.6 | 84.1 | 95.1 |
| 135.1 | 138.4 | 144.3 | 146.8 | 149.7 | Height | 134.4 | 137.5 | 141.7 | 145.9 | 149.7 |
| 20.8 | 21.6 | 22.3 | 23.2 | 24.4 | Hip Width | 21.0 | 21.7 | 22.9 | 24.0 | 25.3 |
| 60.9 | 62.8 | 64.9 | 67.7 | 70.7 | Chest Circ. | 57.8 | 59.9 | 62.8 | 65.8 | 69.0 |
| 25.7 | 26.8 | 28.1 | 29.5 | 31.4 | Leg Girth | 25.6 | 26.8 | 28.3 | 29.9 | 31.8 |

**Table 60 Selected Percentiles for Five Body Measurements Ages 5 to 13½ years** *(Continued)*

| Boys | | | | | | Girls | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Percentiles | | | | | | Percentiles | | | | |
| 10 | 25 | 50 | 75 | 90 | | 10 | 25 | 50 | 75 | 90 |
| | | | | | 11 Years | | | | | |
| 66.3 | 71.6 | 77.6 | 87.2 | 99.3 | Weight | 62.6 | 69.9 | 78.8 | 89.1 | 100.4 |
| 137.3 | 140.5 | 144.2 | 149.2 | 151.8 | Height | 137.0 | 140.3 | 144.7 | 149.2 | 153.4 |
| 21.1 | 21.8 | 22.6 | 23.5 | 24.8 | Hip Width | 21.4 | 22.2 | 23.5 | 24.6 | 26.0 |
| 61.7 | 63.7 | 65.9 | 68.8 | 71.9 | Chest Circ. | 58.6 | 61.1 | 64.2 | 67.2 | 70.5 |
| 26.0 | 27.1 | 28.5 | 30.0 | 32.0 | Leg Girth | 26.0 | 27.3 | 28.9 | 30.6 | 32.6 |
| | | | | | 11½ Years | | | | | |
| 69.2 | 74.6 | 81.0 | 91.6 | 104.5 | Weight | 66.1 | 74.0 | 83.2 | 94.0 | 106.0 |
| 139.8 | 142.9 | 146.9 | 151.4 | 154.8 | Height | 139.8 | 143.1 | 148.1 | 152.9 | 157.0 |
| 21.5 | 22.2 | 23.1 | 24.0 | 25.3 | Hip Width | 21.9 | 22.8 | 24.2 | 25.4 | 26.8 |
| 62.5 | 64.6 | 66.9 | 69.9 | 73.1 | Chest Circ. | 59.6 | 62.5 | 65.5 | 68.5 | 72.2 |
| 26.4 | 27.6 | 29.0 | 30.6 | 32.8 | Leg Girth | 26.6 | 27.9 | 29.5 | 31.2 | 33.2 |
| | | | | | 12 Years | | | | | |
| 72.0 | 77.5 | 84.4 | 96.0 | 109.6 | Weight | 69.5 | 78.0 | 87.6 | 98.8 | 111.5 |
| 142.4 | 145.2 | 149.6 | 153.5 | 157.9 | Height | 142.6 | 145.9 | 151.5 | 156.6 | 160.6 |
| 21.9 | 22.6 | 23.5 | 24.5 | 25.8 | Hip Width | 22.4 | 23.4 | 24.9 | 26.2 | 27.6 |
| 63.3 | 65.5 | 67.8 | 70.9 | 74.2 | Chest Circ. | 60.6 | 63.8 | 66.7 | 69.7 | 73.8 |
| 26.8 | 28.0 | 29.5 | 31.2 | 33.5 | Leg Girth | 27.1 | 28.5 | 30.1 | 31.8 | 33.8 |
| | | | | | 12½ Years | | | | | |
| 74.6 | 80.6 | 83.7 | 102.0 | 116.4 | Weight | 74.7 | 83.7 | 93.4 | 104.9 | 118.0 |
| 144.5 | 147.5 | 152.3 | 157.2 | 161.6 | Height | 145.9 | 149.3 | 154.3 | 159.1 | 162.7 |
| 22.3 | 23.1 | 24.1 | 25.1 | 26.5 | Hip Width | 23.0 | 24.0 | 25.5 | 26.8 | 28.3 |
| 64.2 | 66.5 | 69.1 | 72.4 | 75.8 | Chest Circ. | 61.8 | 64.9 | 67.7 | 70.9 | 75.3 |
| 27.3 | 28.6 | 30.1 | 32.0 | 34.2 | Leg Girth | 27.7 | 29.1 | 30.7 | 32.4 | 34.3 |
| | | | | | 13 Years | | | | | |
| 77.1 | 83.7 | 93.0 | 107.9 | 123.2 | Weight | 79.9 | 89.4 | 99.1 | 111.0 | 124.5 |
| 146.6 | 149.7 | 155.0 | 160.8 | 165.3 | Height | 149.1 | 152.6 | 157.1 | 161.5 | 164.8 |
| 22.7 | 23.6 | 24.6 | 25.6 | 27.2 | Hip Width | 23.6 | 24.6 | 26.0 | 27.4 | 29.0 |
| 65.0 | 67.4 | 70.3 | 73.8 | 77.4 | Chest Circ. | 62.9 | 65.9 | 68.6 | 72.0 | 76.7 |
| 27.8 | 29.2 | 30.8 | 32.7 | 34.8 | Leg Girth | 28.2 | 29.7 | 31.2 | 32.9 | 34.8 |
| | | | | | 13½ Years | | | | | |
| 82.2 | 89.6 | 100.3 | 115.5 | 130.1 | Weight | 85.5 | 94.6 | 103.7 | 115.4 | 128.9 |
| 149.4 | 153.1 | 158.9 | 164.6 | 168.9 | Height | 151.1 | 154.4 | 158.4 | 162.6 | 165.9 |
| 23.2 | 24.1 | 25.2 | 26.4 | 27.8 | Hip Width | 24.2 | 25.2 | 26.5 | 27.8 | 29.5 |
| 66.3 | 68.8 | 72.4 | 75.8 | 79.4 | Chest Circ. | 63.8 | 66.6 | 69.3 | 72.9 | 77.7 |
| 28.5 | 29.9 | 31.6 | 33.4 | 35.3 | Leg Girth | 28.7 | 30.2 | 31.6 | 33.4 | 35.1 |

(From Stuart, H. C., and Meredith, H. V.: Use of Body Measurements in the School Health Program. Am. J. Public Health. Vol. 36.)

## DIET AND OLD AGE

The nutritive requirements of old age do not differ materially from those of middle life, but for two reasons the diet of the aged person should be given consideration: first, because some of the loss of vigor which accompanies advancing years may be hastened or retarded by dietary means, second, because adequate nutrition is often more difficult to maintain in the aged because of economic limitations, development of

fixed ideas concerning food likes and dislikes the limitations of diet often imposed by absence of teeth and other such factors Such considerations must govern the arrangement of the diet

*Man s period of reproductive activity can probably* be extended to an appreciable degree by dietary means if the effort is begun in early youth and is a sustained one This has been demonstrated repeatedly on the lower animals Indeed the preservation of youthful vigor with continued fertility is one of the criteria by which students of nutrition judge the adequacy of an animal s ration But this is of little interest to the man who has turned into the last quarter stretch and already is beginning to feel the limitations of years To what extent can he profit by attention to diet? Only to a limited extent but the effort is worth while

Within limits thinness favors longevity The truth of this is seen not only in life insurance statistics but also in animal experiments notably in those of McCay[15] who found that rats forced to keep thin had significantly longer spans of life This principle however does not apply when thinness is extreme When according to McCay greatest body weight is compared with maximal length of life it will be found that the rats that have attained intermediate maximal weight are more often favored with a long life If the weight of a rat falls below a certain level or goes far above it the life span is shortened To attain longevity and to lengthen his period of usefulness then man should endeavor studiously to avoid the excessive weight which often comes with advancing years

On the other hand too much dietary restriction as is frequently practiced is distinctly harmful Overnutrition (fat) as Touhy[16] pointed out hastens the development of pathologic change while undernutrition produces disorders which are merely physiologic the latter nonetheless are equally disturbing Undernutrition may not hasten senility but to a grievous extent it lessens the aged person s vigor and sense of well being To enjoy sustained vigor the elderly person must have sufficient food of *the right kind His total caloric intake should* approach that recommended by the Food and Nutrition Board that is 2400 Calories for the sedentary man of 70 kilograms and 2000 Calories for the woman of 56 kilograms The tea and toast schedule for grandma is out

Body weight is the best guide to adequacy of caloric intake It is believed that maintenance of a weight height relationship approximating that of desirable weights (Table 131 in Appendix) is to be encouraged[17]

The protein quota of the aging person s diet should be more liberal than is commonly allotted Carbohydrates and fats should be taken in amounts sufficient to bring the caloric value of the diet to the proper figure but greatest emphasis should be laid on carbohydrate The necessity for vitamins and minerals is probably not different in old age from that in middle life

No effort is made here to suggest specific articles which the aged person should eat This can be left to appetite and to other circumstances Milk or milk products such as cheese eggs tender meats fruits and green vegetables (puréed if necessary) should all be included The food should not be rich or highly seasoned and it should not be bulky

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# 12

## *Feeding of Infants*

P. C. JEANS, M.D.*

The feeding of infants is based on the same fundamental principles of nutrition as the feeding of persons at any other age. The chief differences lie in the functional immaturity of the digestive apparatus and the relatively great requirement for food in infancy. The difference between the amount of food required and the amount that can be digested and utilized is relatively small. Indiscretions in diet lead more quickly to harmful effects. Thus dietary prescriptions for infants are necessarily more precise than those for older normal persons. Despite this fact, considerable latitude is permissible in the choice and quantity of prescribed food, and the feeding of a normal infant is a relatively simple procedure.

### FOOD REQUIREMENTS

**Protein.** Because the average thriving breast-fed baby receives from 2 to 2.5 gm. of protein each day for each kilogram of body weight, this amount has been accepted as a good standard. Because of the concept, which has been questioned for the human being, that cow's milk protein has a somewhat lower biologic value than human milk protein, the standard for cow's milk protein is considered as 2.5 to 3 gm. daily for each kilogram. Customary dilutions of cow's milk supply a minimum of 3.5 gm.

**Fat.** Except for a possible unproved need for certain unsaturated fatty acids, there seems to be no fat requirement. Since young children have been known to thrive for long periods while receiving a diet as low in fat as is practicable, it may be concluded that any requirement that exists is easily satisfied.

**Carbohydrate.** Carbohydrate in some form should supply at least 25 per cent of the calories furnished by the fat and carbohydrate of the diet. Twenty per cent is the minimum that will ensure proper utilization of fat by the normal adult. Babies are somewhat less efficient in burning fat than are adults. The requirement is far less than the amount of sugar babies receive from any ordinary diet.

* Professor of Pediatrics, State University of Iowa, Iowa City.

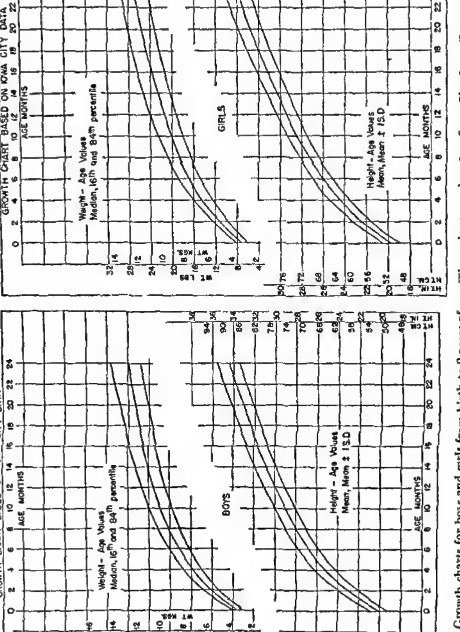


*Fig 8 Growth charts for boys and girls from birth to 2 years of age.* These charts are based on Iowa City data. (Jeans and Marriott: Infant Nutrition. St. Louis, C. V. Mosby Co)

**Energy.** Although the carbohydrate requirement is small and the fat requirement almost nonexistent, these two materials, together with protein, are used to satisfy a relatively large energy requirement. In customary diets for infants, protein supplies from 9 to 16 per cent of the total calories, the remainder being obtained from fat and sugar. In the early months of the first year the energy requirement is approximately 55 Calories daily for each pound of body weight (120 for each kilogram). Late in the first year the requirement decreases to approximately 45 Calories to the pound (100 to the kilogram). Unless this energy requirement is met, the infant will not grow as he should.

**Water.** The requirement of the baby for water is relatively much greater than that of the adult, being for each day 10 to 15 per cent of the body weight. This amount is easily supplied by the milk received by the breast-fed baby or by customary formulas of the artificially fed baby. Some additional water in the summer may be advisable.

**Mineral Salts.** When an infant receives customary amounts of either human or cow's milk, the requirements for mineral salts are met, with the exception of the requirement for iron. Iron is supplied in the dietary supplements.

**Vitamins.** The breast-fed baby who is thriving may be considered to be receiving an adequate amount of all the necessary vitamins with the exception of vitamin D. The customary milk diet of the artificially fed infant contains vitamin A and riboflavin in relative abundance. The amount of thiamine is small, but with adequate ingestion of milk the minimum requirement is met. It is good practice to supplement the diet early with foods containing significant amounts of thiamine, such as egg yolk, fruits and vegetables. The proprietary cereal foods for infants are fortified with the B vitamins. The amount of ascorbic acid is adequate in human milk when the mother is well fed, but the amount in cow's milk rarely may be expected to meet the requirement. It is desirable that all babies receive some source of ascorbic acid from the early days of postnatal life. A suitable allowance of ascorbic acid for the early weeks is 15 mg. daily; after three months the daily allowance should be 30 mg. or more. Vitamin D should be supplied to all infants in the amount of 300 to 400 units daily. One teaspoonful of minimum standard cod liver oil contains 310 units of vitamin D, other cod liver oils as high as 900 units.

## BREAST FEEDING

Infant mortality statistics continue to show a definite advantage of natural over artificial feeding. This advantage is more marked when the feeding is unsupervised. With an adequate supply of human milk all the nutritional needs of the baby may be considered as met with the exception of those for iron and vitamin D, although the B vitamins may be present in minimum amounts. Although the breast-fed baby usually does not need additional ascorbic acid, it is good practice to include orange juice or its equivalent in the diet. Thus it becomes advisable to give the breast-fed baby the same dietary supplements as are advised for the artificially fed baby.

Contraindications to breast feeding are few They are chiefly tuberculosis and chronic illness of the mother During acute illness of the mother temporary weaning may be necessary the secretion of milk being kept active by mechanical emptying of the breasts Syphilis either congenital in the baby or acquired by the mother before the birth of the baby is not a contraindication to breast feeding except in the rare instances in which syphilis is acquired by the mother so late in her pregnancy that the infection is not transmitted to the baby before birth The most frequent cause for early weaning is grossly deficient secretion of milk

**Technic of Breast Feeding** The baby should be placed at the breast six to twelve hours after birth every six hours for twenty four hours and then every four hours The amount of colostrum secreted during the first few days is small and the baby should be offered both breasts at each nursing in order to stimulate the secretion of milk During this period of meager secretion the baby should be given water or a 5 to 10 per cent solution of sugar after each nursing Most babies show signs of hunger after forty eight hours Unless the secretion of milk has increased considerably by the third or fourth day supplementary artificial feeding is desirable

When the secretion of milk has become established the baby should be fed at either three or four hour intervals depending on the quantity of milk available When the milk is abundant and the baby takes it well the four hour schedule is more satisfactory also it is desirable and frequently possible to have only five feedings in the twenty four hours with an eight hour interval at night Whatever schedule becomes established at least moderate regularity in following it is desirable The baby should be permitted some latitude in establishing his own schedule for too rigid conformity is not to be recommended

Under normal conditions the supply of milk is sufficiently abundant that the infant obtains an adequate amount from a single breast and it is desirable to offer the breasts alternately one at one nursing and the other at the next In this way each breast is more thoroughly emptied and the production of milk is encouraged The average nursing time at the breast is fifteen minutes or less If a much longer time than this is taken by the baby the quantity of milk available should be investigated by weighing him before and after nursings Computing the caloric value of milk at 20 Calories to the ounce the total amount should be sufficient to supply the energy requirement

**Difficulties in Breast Feeding** Overfeeding may occur when the mother has excessive and freely flowing milk or when the baby is fed at short intervals Overfeeding with human milk may lead to nothing more than excessive gain in weight but more frequently evidences of indigestion are apparent with colic as the chief manifestation For correction of overfeeding the interval between feedings may be lengthened the nursing time decreased or an early feeling of satiety established by the administration of water just prior to nursing

The most frequently encountered difficulties in breast feeding are those caused by an inadequate supply of milk The associated hunger discom

fort and even vomiting are often erroneously attributed to qualitative defects in the milk. The diagnosis of underfeeding is easy to establish by weighing the baby before and after feedings. If the deficiency of the milk supply is only moderate, the baby should be given supplemental feeding of a cow's milk formula after each nursing at the breast. With more marked deficiency, weaning usually is desirable.

Weaning. From clinical experience it seems a wise rule that with few exceptions all infants be weaned from the breast at eight to ten months of age. The chief exception would be an infant who is acutely ill. Summer is not a contraindication to weaning if the hygiene of the home is satisfactory and the baby is under supervision. It is preferable to wean gradually by progressively increasing the number of artificial feedings substituted for nursing at the breast. When weaning is carried out in this manner after the infant is six months of age, modification of the cow's milk other than by boiling and perhaps by the addition of sugar is unnecessary. For abrupt weaning, moderate dilution of the milk for a few days is desirable. When weaning is carried out late in the first year, usually it is desirable to wean to cup and spoon rather than to the bottle.

## ARTIFICIAL FEEDING OF NORMAL INFANTS

In the absence of human milk, cow's milk is usually chosen to form the basis of the infant's diet. The milk should contain 4 per cent of fat or less. If the milk from Jersey or Guernsey cows is used, it should be partially skimmed. Even though the milk may be of certified grade or has been pasteurized, it should be boiled for the feeding of infants.

Cow's milk differs from human milk in a few major and in numerous minor respects. From the standpoint of digestion and utilization the chief difference is in the density of the curd formed in the stomach. Because of the density, size and relative indigestibility of the curd of cow's milk, some variety of modification of the milk is desirable and usually necessary for the young infant. The boiling of milk produces changes that cause a finer curd to form. In addition, the milk is usually modified further by dilution or by acidification, or by both. The changes brought about by these procedures result in the formation of a casein curd that is easily digestible. In order to increase the energy value to a satisfactory level and to attain suitable acid base relationships in the intestinal tract, sugar is added.

Dilution formulas consist of a mixture of boiled milk, water and sugar. The amount of milk to be prescribed for young babies varies from 1.5 to 2 ounces daily for each pound of body weight (100 to 130 cc for each kilogram). For most babies 1.75 ounces for each pound (110 cc for each kilogram) approaches the optimum. The amount of sugar to be added is, in general, that which will increase the caloric value of the mixture to the energy requirement of the baby. On this basis the quantity of sugar varies directly with the age of the baby, being approximately 1 ounce (30 gm.) daily for the younger baby and 2 ounces (60 gm.) or more daily for the older baby under eight months of age. After eight months the amount of sugar usually is decreased. The quantity of sugar added for the younger baby will approximate 6 per cent of the total

formula The amount of water to be added is that which will increase the total volume of the formula to the volume predetermined as a suitable intake for one day The total volume of the twenty four hour formula should rarely exceed 35 ounces (1050 cc) The normal young infant may be expected to take at each feeding from 2 to 3 ounces more than his age in months The number of feedings each day does not exceed seven for the normal young infant or five for the older infant

The energy value of a formula is calculated on the basis of 20 Calories for each fluid ounce (660 to the liter) of whole milk and 120 Calories for each ounce avoirdupois (4 Calories to the gram) of sugar The energy requirement is calculated on the basis of weight as discussed previously, but it should be calculated on the basis of expected weight or what the baby should weigh if he were entirely normal The recommendation of 1 75 ounces of milk daily for each pound (110 cc for each kilogram) applies only until the calculated quantity for the day becomes approximately 1 quart (1 liter) thereafter 1 quart (1 liter) of milk daily is the customary allowance By the time the baby is receiving this quantity of milk many other foods should have been added to the diet with no need for additional milk

A set of rules such as has been presented may only approximate the need of any individual baby and should not be followed too literally If a baby is hungry there is rarely no reason for not allowing him more food Babies vary from time to time as to appetite in ordinary circumstances they should not be forced to empty each bottle merely because the quantity has been prescribed

**Technic of Food Preparation and Feeding** It is customary and appropriate to prepare the twenty four hour formula at one time and to divide it into bottles according to the number of feedings When fresh milk is used the process of preparation is simplified by mixing all the ingredients before boiling Rapid boiling and rapid cooling are preferable The clean sterile filled and stoppered bottles are kept refrigerated until ready for use As needed the milk is warmed to body temperature and fed to the baby preferably in arms and in a semireclining position The hole in the nipple should be of such size that when the filled bottle is inverted the milk drops rapidly but does not run in a stream After the feeding is completed the baby should be held upright and perhaps patted to assist in the eructation of swallowed air Some babies need to be held upright once or twice during the feeding

## Various Infant Foods

**Sugar** The carbohydrates commonly used in infant feeding are lactose sucrose starch and derivatives of starch (dextrin maltose dextrose and mixtures of these derivatives) Numerous mixtures of dextrin maltose and dextrose are commercially available under various proprietary names Most of them have been prepared by the action of malt diastase on starch and are marketed as a dry powder Another product commonly used is prepared by the action of mineral acid on corn starch it is marketed as a syrup after the addition of 15 per cent sucrose syrup or refiners syrup for flavoring

**Table 61 Outline for the Feeding of Normal Infants with Mixtures of Whole Sweet Milk***

| Age | Weight | | Milk | | Sugar | | Water | | Feedings | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Amount | |
| Mo | Pounds | Kilo grams | Fl d Ounces | Cc | Ounces | Grams | Fluid Ounces | Cc | No in 24 Hr | Ounces | Cc. |
| 1/4 | 7 1/2 | 3 4 | 12 | 360 | 1 | 30 | 6 | 180 | 7–6 | 2 1/2 | 75 |
| 1/2 | 8 | 3 6 | 14 | 420 | 1 | 30 | 7–10 | 210 300 | 7–6 | 3 4 | 90–120 |
| 1 | 10 | 4 5 | 18 | 540 | 1 1/4 | 35 | 12 | 360 | 6–5 | 5 6 | 150 180 |
| 2 | 11 1/2 | 5 2 | 20 | 600 | 1 1/2 | 45 | 10 | 300 | 6 5 | 5–6 | 150 180 |
| 4 | 14 1/2 | 6 6 | 25 | 750 | 1 3/4 | 50 | 11 | 330 | 5–6 | 7–6 | 210 180 |
| 6 | 17 1/2 | 7 9 | 30 | 900 | 2 | 60 | 5 | 150 | 5 | 7 | 210 |
| 8 | 20 | 9 1 | 32 | 960 | 1 1/2 | 45 | 0–3 | 0–90 | 4 5 | 8 7 | 240 210 |

* In all instances these formulas are to be supplemented with orange juice cod liver oil and other foods as discussed in the text After the age of 8 months the amount of milk does not exceed 1 quart and the amount of sugar added is gradually decreased Usually no sugar is added after the age of 1 year

All the sugars mentioned serve the needs of the infant equally well after absorption from the intestinal tract For practical purposes they are interchangeable in the feeding of the normal infant The important differences between them lie in their behavior in the intestinal tract Some of the sugars are more laxative than others Dextrose is absorbed so readily that it has practically no laxative effect Lactose is absorbed slowly, and a definite laxative effect is obtained easily Most of the malt sugars are intermediate between dextrose and lactose in effect, except *that the malt sugars to which potassium carbonate has been added* are usually more laxative than is lactose

All dry sugars supply 120 Calories to the ounce avoirdupois (4 Calories to the gram) A weighed ounce of each of the sugars has a volume in fluid ounces as follows cane sugar, 1, lactose, 2, dextrose, 2, and dextrin maltose mixtures, 2 One fluid ounce of flavored corn syrup contains 1 ounce of sugar by weight Volume is best measured in a graduate or medicine glass However, 2 level tablespoonfuls may be considered 1 ounce by volume

**Acidified Milk** When the curd of milk is appropriately coagulated by means of acid it is easily digested by the infant without further modification by dilution It may be fed diluted or not according to desire or indication The feeding of undiluted milk is of advantage in the *infant with small gastric capacity* and the feeding of acidified milk is advantageous for the infant who is ill or malnourished and as a consequence has deficient gastric secretion For acidification either lactic or citric acid is commonly used The quantity of *lactic acid* (U S P, 87 per cent) usually given is 1 teaspoonful (100 to 120 drops) to the quart of milk and of citric acid, 2 gm (2 teaspoonfuls of a 25 per cent solution or 1/2 level teaspoonful of the dry powder) to the quart The milk is first boiled and then cooled When the milk is cold, the acid is added,

the lactic acid should be added slowly, drop by drop, with stirring the addition of citric acid in solution can be made more rapidly and less cautiously Acidified milk is thicker than sweet milk and requires a larger hole in the nipple

**Evaporated Milk** Evaporated milk when diluted with an equal volume of water is slightly more concentrated than the original milk, but may be used in the same manner as whole fresh milk, except that for very young infants greater dilution is desirable Because of homogenization and the heat treatment to which it has been subjected, the casein is considerably altered and is more easily digested than that of unmodified fresh milk If acid is added only two thirds as much acid is required as for fresh milk Boiling is unnecessary, the product is already sterile and has had much heating The water used for dilution, however, should be boiled

**Dried Whole Milk** When 1 ounce by weight (approximately 4 packed level tablespoonfuls) of dried whole milk is mixed with water to a volume of 8 fluid ounces (12 gm to 100 cc), the equivalent of the original whole milk is obtained, and the resulting product may be used as whole milk The casein has been much modified by the processing and the addition of acid usually is not indicated

**Dried Skim Milk** Most of the dried skimmed milks marketed specifically for infant feeding are prepared from milk containing 1 to 1 5 per cent fat Such may be reconstituted to its original volume if 1 ounce by weight of the powder is mixed with water to a volume of 10 fluid ounces (10 gm to 100 cc) Because of the decreased energy value in comparison with that of whole milk it is customary to prescribe it in infant feeding in greater than normal concentration One common method of using the product is to prescribe for a day s feeding 1/3 ounce for each pound of body weight (22 gm for each kilogram), diluted to the volume that the infant is expected to take in the twenty four hours When this quantity is used less sugar is required than for the usual whole milk feedings Each ounce of dried skimmed milk by weight (30 gm) contains approximately 3½ packed level tablespoonfuls and supplies 125 Calories

**Vitamin D Milk** Most of the evaporated milk on the market has been fortified with vitamin D to the extent that a reconstituted quart contains 400 units Dairies in increasing number are fortifying milk in a similar manner The material used for fortification may be a concentrate of fish liver oil of irradiated ergosterol (vitamin $D_2$) or of irradiated 7 dehydrocholesterol (vitamin $D_3$) Of all foods milk is the most suitable as a carrier of vitamin D When babies receive milk with 400 units to the quart in customary amounts the requirement for vitamin D is fully satisfied

**Synthetic Proprietary Food Mixtures** It is apparent that an appropriate milk formula can be prepared freed from some or most of its water and preserved in suitable containers It is then ready for use after the addition of water Numerous mixtures of this type are marketed In the preparation of some of them an attempt is made to simulate human milk Others are more simple mixtures of milk and sugar Of whatever

advantages such mixtures may have, perhaps the chief one is convenience A few of these mixtures, such as sweetened condensed milk because of a disproportionately high sugar content, are nutritionally unbalanced and are not suitable for routine infant feeding although they may have their special uses

### FOODS OTHER THAN MILK

In addition to human or cow s milk the baby requires vitamin D from early after birth and iron after the first two to three months The artificially fed baby also requires ascorbic acid very early When the diet of the mother of a breast fed baby contains an abundance of vitamin C her milk will supply ample for the baby Average human milk however, contains only about half as much ascorbic acid as does the milk of a well fed mother, and the giving of orange juice to the baby serves as an added safeguard as well as to accustom the baby to this food that will become more necessary later Because the amount of thiamine in the basic diet is little more than the minimum requirement, early addition of foods containing this vitamin is desirable Beginning when the baby is about two weeks of age both cod liver oil and orange juice should be given If desired the dose of cod liver oil may be small at first and increased rapidly until an amount containing 300 to 400 units of vitamin D (usually 1 teaspoonful) is taken daily This amount of vitamin D is adequate to supply the need throughout the period of infancy If a concentrate is used to supply vitamin D, the amount should be such as will supply 400 to 600 units daily The orange juice also may be given in small amounts at first but the amount should be increased rapidly until 1 ounce is taken daily After the age of three months it is customary to give 2 ounces daily Orange juice is commonly given about one hour before one of the morning feedings

Egg yolk is a fairly good source of iron and thiamine Cooked egg yolk may be given advantageously as early as at the age of two or three months although it is given more commonly at about four months It may be mixed with the milk formula made into a simple custard or fed with a spoon after being boiled sieved and moistened with milk

Vegetables and fruits are commonly fed at the age of three to four months They should be well cooked and finely sieved Fruits (prunes apples peaches apricots) may be given first as soon as these are well taken vegetables (tomatoes spinach string beans peas carrots beets asparagus cauliflower) may be offered These foods are given in the beginning in quantities of 1 to 2 tablespoonfuls daily and the quantity increased rapidly to at least 2 ounces daily

Sieved cereal although not essential may be added at six to seven months The amount served should not exceed 2 fluid ounces It is advisable to defer the feeding of cereal until fruits and vegetables are well taken and not to permit it to replace either of these foods Certain compounded proprietary cereal foods may be given much earlier and may even replace to some extent some of the fruits and vegetables because of the content of iron and thiamine Many physicians start the

feeding of the proprietary cereal foods to babies as young as three months

Between the ages of eight and ten months sieved fruits and vegetables may be served twice daily with a graham cracker or half a slice of toast Also at about this age it is desirable to offer at least one food daily that is mashed or chopped rather than sieved this is for the purpose of promoting good feeding habits by accustoming the baby to variety in texture Variety in flavor presumably has been obtained by the foods already mentioned

After ten months of age the same foods are given but some of them in larger quantity The daily quantity of vegetables should approximate 3 or 4 ounces at first and 4 or 5 ounces later The quantity of fruit should be 2 or 3 ounces and later 4 or 5 ounces Instead of egg yolk the whole egg is given Scraped or ground meat may replace the egg several times weekly or may be given in addition to the egg If desired suitably prepared meat may be given at a much earlier age sieved boiled liver for example is well tolerated at an early age These comments concerning meat refer to home prepared products Sieved and diced meats are commercially available the sieved products can be fed in the early months if desired

The foods that have been named may be considered an essential part of the diet and should be given daily As the infant grows older and his caloric needs increase other foods are added but not in replacement of any of the essential foods At any age desired the diet may be increased by such foods as bread cereal and potato Further variety may be attained by methods of preparation and variations in combinations of foods—for example vegetable milk soups

## FEEDING OF INFANTS UNDER SPECIAL CONDITIONS

Whenever an infant is ill from any cause his ability to digest and utilize food is likely to be impaired and gastrointestinal disturbances may result At times the underlying cause of the disturbance is relatively mild or obscure and the digestive symptoms are outstanding The most frequent cause of indigestion in babies under supervision is infection of the upper respiratory tract Excessive heat of summer may act in much the same manner as illness in producing indigestion if heat is permitted to be retained by the baby It is only occasionally that teething may be considered a cause of digestive upset Gastrointestinal disturbances from these extraneous causes are varied in their manifestations There may be anorexia vomiting abdominal discomfort (colic) or diarrhea or a combination of these symptoms

Vomiting Vomiting may be produced by ingestion of wholly improper foods by gastric distention by illness that impairs digestion and permits gastric stasis and by obstruction (pyloric stenosis) Occasionally infants acquire a habit of rumination or voluntary vomiting At times vomiting represents a reaction against forced feeding and overattention to food on the part of the mother

Gastric distention may result if food is ingested too rapidly or if it is ingested at such short intervals that the stomach contains considerable

food when the next feeding time arrives Some infants seem to have an unusually small stomach capacity they should be given small volumes of concentrated food A relatively common cause of regurgitation and vomiting is the presence in the stomach of air that has been swallowed usually in the course of feeding Every baby should be held up after feeding so as to permit regurgitation of air If eructation is accomplished with difficulty and if vomiting presumably is caused by swallowed air the baby can be placed in bed after feeding with the shoulders higher than the buttocks

The vomiting associated with illness cannot always be controlled but control is aided greatly by the giving of a food that tends to pass through the stomach more readily than the usual feedings Such a food would be low in fat and especially for young babies given with an acid addition Thus acidified skimmed milk is useful

*Pyloric stenosis* is a cause of projectile vomiting that usually has its onset in the first six weeks after birth Gastric peristaltic waves are visible especially immediately after a feeding A pyloric tumor often may be felt A considerable proportion of babies with pyloric stenosis respond well to nonsurgical treatment For the artificially fed baby medical management consists in the administration of atropine before each feeding and the giving of food thickened by the addition of cereal or flour The appropriate dose of atropine is 2 to 4 drops of a 1 1000 solution an amount slightly less than that which causes flushing The cereal addition is from 8 to 10 per cent of the total feeding an amount sufficient to make the food thick and stiff If after a short period of trial these measures are unsuccessful the Rammstedt operation is indicated For the breast fed baby operation is indicated if a suitable response to atropine does not occur the baby should not be weaned

Rumination and vomiting resulting from overattention in feeding represent neuroses that may be managed most satisfactorily by complete change in environment including a change of caretaker Rumination is often helped also by the use of a thickened feeding as for pyloric stenosis

**Colic** Colic is largely a symptom of indigestion and may result from any of the causes of indigestion discussed Symptoms indistinguishable from those of colic may result from hunger and underfeeding Excessive swallowing of air is associated often with underfeeding and also with abdominal discomfort whether the presence of air in the intestine is of itself a cause of colic is debatable The treatment of colic consists chiefly in giving an appropriate formula designed to relieve indigestion or underfeeding In breast fed babies the abdominal distress is often relieved by giving an ounce of boiled skimmed milk before each nursing

**Diarrhea** In former years diarrhea was more prevalent in the summer and could be attributed largely to the effect of retained heat in the body and growth of bacteria in milk unhygienically produced and preserved In some measure also it could be attributed to lack of knowledge of proper prescriptions for milk formulas To a large extent all these difficulties have been overcome The milk supply is more likely to be sanitary and milk formulas for babies are commonly prepared with boiled milk Prescription of a formula has become a relatively simple

procedure For these reasons it has come about that in the majority of instances the causative factor in diarrhea is an infection in some location other than in the intestinal tract The infection may be a simple cold or mild otitis media In many instances the symptoms of otitis media are referable almost entirely to the gastrointestinal tract Diarrhea caused by specific infection of the intestinal tract (dysentery) or by wholly improper feeding is still encountered occasionally but such instances are exceptional Consequently in most of the cases of diarrhea it should become a rule to seek the focus of parenteral infection and apply appropriate treatment Diarrhea dependent on parenteral infection does not respond satisfactorily to dietary therapy as long as the infection continues active

In recent years what appears to be a new cause of diarrhea has come to attention It tends to occur in epidemics and at least in many instances apparently has a virus as the cause Presumably the infection is parenteral It affects the newborn more frequently and more seriously than older babies and often is the cause of death

In cases of diarrhea from enteral infection the usual cause is bacillary dysentery Sulfonamides or antibiotics or combinations of both have a prompt effect on dysentery The fever subsides and the diarrhea decreases greatly within a day or two after starting treatment Until the diagnosis is made and specific therapy is started the treatment should be similar to that for diarrhea from other causes If the diarrhea is severe parenteral administration of food and fluids is indicated Otherwise the baby can be fed boiled skimmed milk with added dextrose

The treatment of diarrhea from causes other than infection of the intestinal tract is governed by its relative severity An occasional loose stool or a slight increase in the number of stools is not an invariable indication for change in the food provided the infant continues to gain and exhibits no other symptoms In general the indication in diarrhea is to diminish or temporarily to withdraw food completely A short period of food deprivation allows the intestine to empty Especially when diarrhea is sufficiently severe to require starvation the intestinal tract is emptied rapidly and a cathartic is not indicated

Starvation is used only for severe diarrhea and in most instances for only a brief period A mild disturbance may respond to the omission of one or two feedings For more severe diarrhea a fast of twenty four hours may be desirable When diarrhea is severe and is accompanied by shock and a toxic state food should be withheld for as long as the toxic state continues In all instances of diarrhea consideration must be given to maintenance of hydration For mild diarrhea perhaps no special measures are necessary For diarrhea of greater severity fluids must be given parenterally to restore and maintain hydration In those instances in which fasting must be continued over a number of days parenteral alimentation is indicated in addition to water and electrolyte maintenance In severe diarrhea maintenance of the potassium content of the body is to be considered along with that of sodium and chloride

Babies with diarrhea have much less difficulty in digesting and utilizing protein than fat Consequently the first feedings offered may have

*boiled skimmed milk as the basis* The milk may be acidified or i according to the preference of the physician Acidified milk is usu more readily digested The addition of sugar may be delayed for a or two or, if undertaken early, may well be of the monosaccharide t (dextrose) As the diarrhea decreases the food may be changed gra ally to the customary type

*Occasionally cases of moderate diarrhea occur in which the stools* foul and in which foods high in protein and low in sugar have no be ficial effect In these cases the diarrhea often responds promptly t food with high sugar and low *protein content, a type of food represen* by sweetened condensed milk

With the exception of chemotherapy in dysentery, drugs are of r *tively little value in treatment of diarrhea Bismuth preparations so* times are recommended, to be effective these must be given in gener doses Camphorated tincture of opium or other opium preparations r be indicated for partial control of the diarrhea *if the stools continue* be watery and if the loss of fluid is marked after a period of starvati

The apple diet has had some degree of popularity Grated raw ap or its equivalent in canned apple *powder is administered as the sole fo* in some instances with sugar added during the first two or three d of illness In most cases of diarrhea the stools become relatively norr in the period of apple feeding Transition to the regular milk die made gradually through a stage of feeding of skimmed milk with ad sugar It is the practice of some physicians to use a mixture of apple a skimmed milk from the beginning

**Constipation** Milk protein has a constipating effect, whereas sug as a class are laxative Customary formulas for infants contain these t materials in such proportions and are fed in such amounts that neit constipation nor looseness of stools results For some babies howev *because of constipation it becomes desirable to increase* the proporti of sugar of the formula or to use a more laxative type of sugar T prescribing of raw milk because 'boiled milk is constipating' is unwi Acidification of a milk formula often produces the desired effect the baby is three months or more of age and if increasing the sugar the formula within reasonable limits has been unsuccessful in relievi constipation vegetables and fruits can be given or if they are alrea included in the diet, the amount may be increased If a breast fed ba is constipated despite an adequate supply of milk relief frequently m be obtained by giving one of the more laxative varieties of sugar F this purpose a tablespoonful more or less of malt soup extract may given once or twice daily in water or in a small amount of boiled mi It is usually possible to relieve constipation in infancy by dietary mea alone The use of drugs is preferably avoided

**Malnutrition** Infants who are undernourished need as *much food* do those of the same age who are well nourished Marked undernut tion is accompanied by decreased gastric secretion and lowered digesti capacity If the full requirement for food is *satisfied with customa* formulas digestive disturbances may result These infants are mo likely to be able to utilize a formula low in fat and relatively high

sugar than one of usual composition Ability to utilize protein is unimpaired Thus a formula containing skimmed milk or partially skimmed milk with added sugar will usually be found suitable Acidification of the formula is desirable for young infants especially if the milk is fed with as little dilution as may be desirable in order to satisfy the energy requirement For some malnourished infants with small gastric capacity addition to the formula of 1 or 2 ounces of dried skimmed milk is useful in that it serves to increase the energy value without appreciably increasing the volume As improvement occurs the formula may approach gradually the customary mixture appropriate for the age although acidification may be desirable for a considerable period

Infants who are markedly undernourished have lowered blood volume with consequent impairment of circulation which in turn affects the ability to digest and utilize food Also frequently they are more or less dehydrated Administration of fluids parenterally and of several small transfusions at intervals aids greatly in restoring digestive ability and in improving the status generally

In some instances malnutrition is the result of underfeeding exclusively In these cases response to the management described should be prompt In other instances malnutrition is the result of digestive disturbances dependent on parenteral infection and perhaps in addition on some degree of therapeutic underfeeding Full success in these cases will not be attained until the underlying infectious cause receives appropriate treatment The most common sites of infection are the middle ear the mastoid antrum the nose and throat and the genitourinary tract

# 13

# *Nutrition in Pregnancy and Lactation*

Pregnancy and lactation should be regarded as processes of growth Since these physiologic functions are interdependent, it is convenient to think of the unit of time in which they occur as a single interval We may refer to this interval as the "reproductive interlude" During the reproductive interlude the woman's nutritional requirements are higher than at other times in adult life Furthermore, during this interlude numerous finely adjusted metabolic shifts occur These metabolic changes are reflected by readjustments of nutrient levels in the body and altered nutritional requirements

Nutritional diseases may appear which seem to reflect either the increased nutrient requirements or the metabolic changes of the period Examples of such diseases are osteomalacia, sprue, and the megaloblastic anemia of pregnancy In addition, there are many diseases of poorly understood origin which are peculiar to the reproductive interlude Among these may be mentioned nausea and vomiting of pregnancy, toxemia, prematurity, abortion or indeed, even the birth of congenitally imperfect fetus There has been much discussion of the possible relationship between these diseases and nutritive level This will be discussed presently

**Pregnancy.** The normal pregnancy is associated with a weight gain of some 20 to 25 pounds This weight gain is due to (1) the tissue increase represented by the fetal membranes, the growth of the uterus placenta, breasts, and so on, and (2) any increased water retention which may occur Obviously, the building stones for new tissue must come from the foodstuffs consumed during pregnancy or from the storage depots within the mother's body

Not all the increased weight is due to growth of tissue mass Pregnancy, especially during the latter months is normally associated with an increased retention of water in the body[1] The retained water may be evident in the tissues as a mild transitory edema or in the blood as hydremia Hydremia is of universal occurrence in pregnancy Increases in blood volume amounting to 10 to 15 per cent are common, according to Dieckmann and Wegner[2] Increases in plasma volume of 49 per cent and of extravascular volume of 59 per cent during pregnancy above the stabilized postpartum values were found by Caton and his co workers[3] These changes are reflected in a decrease in the hemoglobin level and

erythrocyte count and of the blood serum protein level [1,5] These normal physiologic changes have often been misinterpreted as indicative of nutritive impairment They can no more be considered indicative of deficiency than can the lipemia[4] characteristic of pregnancy be considered evidence of an excessive ingestion of fat

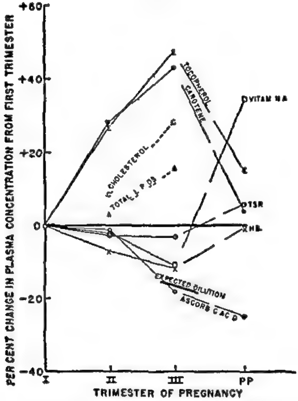


Fig 9 Percentage change in blood concentration of several constituents The expected dilution was calculated from the data of Dieckmann and Wegner [7] the cholesterol and lipid values are from Tyler and Underhill [27] (Darby Cannon and Kaser [6])

Figure 9 illustrates the percentage change in certain blood constituents which occurred during pregnancy and by six weeks post partum in a group of healthy patients at the Vanderbilt University Hospital [6] Note that the changes in content of hemoglobin, total serum protein vitamin A and ascorbic acid were similar in magnitude to those which might be predicted from the expected alterations in blood volume On the other hand the increases in the two fat soluble factors carotene and tocopherol were similar and even exceeded the expected rise in serum lipids and cholesterol The urinary excretion of N methylnicotinamide rises progressively in gestation [6,7] These are but illustrative of the profound alterations in nutritional physiology in pregnancy and the need for careful consideration of normal levels in the reproductive interlude before one interprets values encountered in this period against standards set up for the nonpregnant state

During pregnancy the maternal organism stores certain nutrients Figure 10 indicates the large storage of nitrogen which the maternal

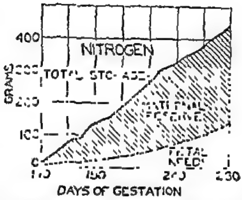


Fig 10 Determined maternal and estimated fetal storage of nitrogen during the final 145 days of gestation The maternal retention greatly exceeds the progressive needs of the fetus and its adnexa (Macy and others[8])

organism accomplishes. This may amount to 200 to 400 gms. of nitrogen stored in excess of that required by the fetus.[9] This quantity of nitrogen is equivalent to 1.5 to 2.5 kilograms of protein. Shortly before delivery the nitrogen balance becomes negative. During delivery, *nitrogen is lost* in the placental membranes and, subsequently, *in the lochia*. With the establishment of lactation, 1 to 1.5 gm. of nitrogen daily will be secreted in the milk. Thus the reserves accumulated during pregnancy serve to

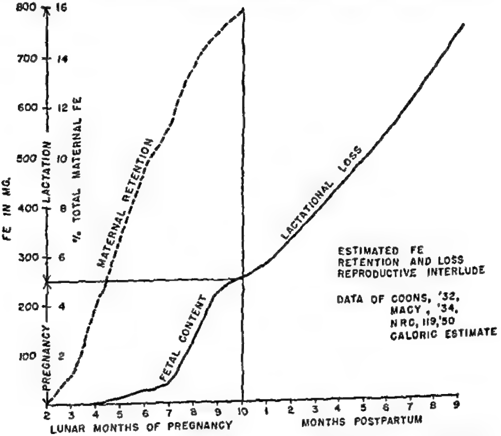


Fig 11 Estimated iron retention and loss by the maternal organism during the reproductive interlude (Constructed from data contained in Coons[28] Macy and Hunscher,[29] and Toverud, Stearns, and Macy[9])

protect against losses during delivery the puerperium, and lactation[9]

A similar storage phenomenon is observed with iron as is illustrated by Figure 11 Here again it is seen that the iron stored by the maternal organism during pregnancy considerably exceeds that required to build fetal tissues It is of some interest that the accumulated iron stores during pregnancy approximate in quantity those which may be expected to be lost in the milk secreted during nine months of lactation This again illustrates the functional benefit which may accrue from such stores

The newborn infant has been estimated to contain[10] approximately 500 gm of protein 24 gm of calcium 14 gm of phosphorus and 0 5 gm of iron Proportional amounts of many of the vitamins and other nutrients are contained in the fetus Thus it is obvious that the maternal organism during pregnancy should accumulate nutrients sufficient to build the fetus and related tissues and to provide for proper storage of nutrients

The magnitude of the nutrient loss during lactation can be appreciated if we recall that at the age of four weeks the mother supplies daily to the infant approximately 6 5 gm of protein 42 gm of lactose 182 mg of calcium 0 6 mg of iron and 20 to 30 mg of ascorbic acid At twenty six weeks of age the infant is provided each day with an estimated 12 gm of protein 76 gm of lactose 326 mg of calcium 1 2 mg of iron and 35 to 70 mg of vitamin C

The nutrient requirements of lactation cannot be estimated directly from data on nutrient losses in milk inasmuch as the secretion of nutrients into milk is not a 100 per cent efficient process The efficiency of transfer of nutrients during lactation is not precisely known

### DIETARY ALLOWANCES DURING PREGNANCY AND LACTATION

Many reviews[9 11 12] have considered the problem of dietary requirements standards or allowances for pregnancy and lactation The foregoing discussion makes it apparent that one cannot set a definite single figure as the minimal requirement for successful physiologic functioning during these complicated processes A considerable body of evidence however supports the view that the allowances[13] suggested by the Food and Nutrition Board of the National Research Council are sufficiently generous that a food intake which supplies these nutrients will offer the maximal nutritional benefits which may be provided during pregnancy and lactation These allowances are given in detail on page 208 and those for major nutrients are indicated in Table 62

These allowances are estimated for a hypothetical average individual and they provide a good margin of safety They are to be regarded therefore as reasonable approximations of desirable intakes It is especially important to retain this attitude in the instance of the caloric allowance since obstetricians hold that the best guide to the adequacy of the caloric intake is the weight gain which the patient exhibits A total gain in weight of 20 pounds or so is frequently stated to be the most desirable from the obstetrical viewpoint and caloric restriction is often imposed upon the patient to avoid gains in weight in excess of this

Table 62 Recommended Daily Allowances[13] During Pregnancy and Lactation
(Food and Nutrition Board National Research Council)

| | Latter Half of Pregnancy | Lactation |
|---|---|---|
| Calories | 2400 | 3000 |
| Protein gm | 85 | 100 |
| Calcium gm | 1 5 | 2 0 |
| Iron mg | 15 | 15 |
| Vitamin A I U | 6000 | 8000 |
| Thiamine mg | 1 5 | 1.5 |
| Riboflavin mg | 2 5 | 3 0 |
| Niacin mg | 15 | 15 |
| Ascorbic acid mg | 100 | 150 |
| Vitamin D I U | 400 | 400 |

figure If this procedure is followed, it is important that the physician advise the patient so that she will not decrease unnecessarily the intake of essential nutrients other than Calories in the diet

The level of nutrient intakes recommended by the Food and Nutrition Board in the Daily Recommended Allowances can be attained through the use of properly chosen foods and without the addition of any dietary supplements Except when there are specific deficiencies there is no indication that a nutrient intake in excess of these quantities will benefit the course of pregnancy, childbirth or lactation

## NUTRITIONAL DEFICIENCY DISEASES DURING PREGNANCY

**Microcytic Hypochromic Anemia** The microcytic hypochromic anemia of iron deficiency may occur during pregnancy but it can seldom be attributed directly to the pregnancy itself The pregnant woman with microcytic hypochromic anemia has entered the state of pregnancy with low stores of iron Although there is an increased need for iron during pregnancy the increased efficiency of absorption of the element[14] would seem to be adjusted to compensate for the need (see p 108) The increased nutritional demands for iron during this period are not sufficiently great to deplete a previously well nourished woman of her iron stores These demands may however increase the severity of an already existing iron deficiency Accordingly early in pregnancy each woman should have an adequate hematologic examination in order to determine whether iron deficiency is present If this and subsequent hematologic examinations reveal maintenance of the hemoglobin level within the usual range for a given period of gestation supplementary iron is unnecessary and is not indicated If however microcytic anemia is found this should be treated with the usual doses of therapeutic iron

**"Pernicious Anemia of Pregnancy** So called pernicious anemia of pregnancy is a rare disease in the United States Although it is frequently macrocytic this is not an invariable characteristic of the disease Occasional cases without macrocytosis are encountered When the anemia is significant however bone marrow studies reveal the presence of megaloblastic hyperplasia in all cases The nature and the successful therapy of this disease with folic acid are discussed in Chapter 24

The occurrence of this megaloblastic anemia in pregnancy is usually associated with a history of a monotonous diet poor in protein from animal sources Whether the disease can be strictly classified as a dietary deficiency remains to be determined It is conceivable that some metabolic peculiarity related to pregnancy accounts for many of those rare cases encountered in the United States At any rate there is no available evidence which supports the thesis that a deficiency of folic acid is common in pregnancy in this country Indeed unpublished studies carried out at Vanderbilt University Hospital have indicated that the routine administration of folic acid during pregnancy does not significantly alter the hemoglobin level of the pregnant woman Furthermore in a study of over 2300 consecutive pregnancies carefully observed in the same hospital clinic throughout the prenatal period not a single case of pernicious anemia of pregnancy was encountered[15] Accordingly we feel that if an adequate dietary is eaten there is no benefit to be derived from the routine supplementation of the healthy pregnant woman with folic acid or other hemopoietic vitamins

**Goiter** It is widely recognized that goiter is more likely to develop during periods of physiologic stress such as pregnancy Accordingly in goitrous or low iodine areas the prophylactic use of iodized salt during the reproductive interlude as well as at other times is advisable Furthermore in areas where iodine deficiency goiter is widespread the administration of iodine in the form of Lugol s solution may be indicated during pregnancy if salt restriction prevents the use of iodized salt as a vehicle for dispensing iodine A reasonable preventive dose of Lugol s solution is 1 drop per week which supplies approximately 0 25 mg of iodine per day

**Other Deficiency Diseases** The extreme rarity of the occurrence of *osteomalacia* and of *beriberi* during pregnancy in the United States renders discussion of these diseases unnecessary Nevertheless the fact of their association with pregnancy in some regions of the world indicates the need for an awareness of pregnancy as a physiologic period during which the consequences of an inadequate diet may become manifest

*Sprue* is another deficiency disease which occurs more frequently during the stress of pregnancy than at other times This is indicated for example by Hanes[16] observation that in his series of thirty female patients with sprue the disease developed in eleven during pregnancy On the North American Continent this disease is rare however

## DISEASES PECULIAR TO PREGNANCY

Studies in experimental animals have demonstrated convincingly that a maternal diet sufficiently poor in any of several nutrients may produce congenital defects in the offspring[17] For example rats born to mothers maintained on a diet low in vitamin A riboflavin or folic acid may exhibit anophthalmos and other eye defects cleft palate and other skeletal abnormalities or hydrocephalus[18] On the other hand it is abundantly evident that other influences are important in the production of congenital malformations Accordingly great caution must be exercised in the translation of these experimental findings in the animal to similar situations in man Reflection on the problem indicates that

under some conditions the placental barrier may play a greater role in influencing fetal nutrition than does the nutrient intake of the mother.

A great variety of ill-understood complications of pregnancy, such as pernicious vomiting, pre-eclampsia, toxemia, prematurity, and even fetal death, have from time to time been related to maternal nutrition. Thus, Mrs. Burke and her associates[19] studied the dietaries of 216 women. They concluded that there was a significant relationship between the quality of the prenatal diet of the mother and the course of pregnancy and the condition of the infant at birth and during the first two weeks of life. Furthermore, it has been reported[20] that, in a series of 400 women, a portion of whose poor diets were supplemented to provide a good intake level, those with good or supplemented diets enjoyed fewer complications of pregnancy and proved to be better obstetrical risks than did those maintained on the poor prenatal diets. The incidence of miscarriages, stillbirths, and premature births in the women on the poor diets was greater than of the supplemented or good diet group. Finally, the incidence of illness in babies up to the age of six months and the number of deaths resulting from these illnesses were greater in the poor diet group.

Other studies have not confirmed these striking findings. The wartime period of starvation in Holland was associated[21,22] with a decrease in the occurrence of toxemia and with no demonstrable effect upon the incidence of stillbirth, neonatal death, or lactation. There did occur a decrease in the birth weight of infants born during this period. In Panama it was not possible to correlate dietary factors with the toxic complications of pregnancy (pre-eclampsia, eclampsia, hypertension, stillbirths, and so on) occurring in over 10,000 deliveries.[23] Indeed, it was suggested that adverse social and psychological factors were important determinative influences in the appearance of these conditions. In a group of 514 women studied in Philadelphia no positive relationship could be found between dietary adequacy and the occurrence of complications of pregnancy.[24] The experience at Vanderbilt University Hospital[15] is consistent with the conclusion that the major factors which influence the occurrence of undesirable pregnancy diseases in the usual obstetrical patient in the United States are non-nutritional.

These and other studies lead one to the conclusion that a generous diet, such as that which meets the recommendations of the Food and Nutrition Board, will provide the pregnant woman with whatever protection she may obtain from nutritional factors. More abundant diets or supplementary factors will not enable the obstetrician to assure his patient of freedom from those undesirable occurrences, such as pre-eclampsia, toxemia, prematurity, and the like. Indeed, as Stander and Bonsnes[25] wrote: "The etiology of the disease remains unknown, although the number of theories, past and present, proposed to explain its causation is legion." Written about toxemia, this epitomizes our position relative to the other pregnancy diseases as well.

**Hyperemesis.** Much has been written of the nutritional control of hyperemesis. Obstetricians widely recognize the difficulty of management of this condition and the great problem of appraisal of therapeutic procedures. Experience indicates that almost any therapeutic agent is suc-

cessful in a limited number of these cases, while other patients are resistant to all therapeutic procedures Nutritional methods of treat ment are no exception to this generalization Perhaps the best founded evidence for an effect of a nutrient can be claimed for that of pyridoxine, for which a biochemical effect on subnormal blood urea levels in hyperemesis has been demonstrated [26] Even here, however, the majority of cases do not respond clinically to pyridoxine therapy It may be fairly stated that massive therapy with large doses of nutrients of the B complex has proved disappointing in the control of this difficult condition

Probably the most important nutritional relationship to bear in mind in hyperemesis is the need for supporting the best possible nutritional condition of the patient Water and electrolyte balance must be main tained and the caloric intake sustained as nearly as possible If the course is protracted and severe, parenteral feedings of amino acids should be considered The water soluble B vitamins and ascorbic acid may be given along with other parenteral alimentation

## SUMMARY

It is the responsibility of the physician to see that his patient enters pregnancy in a good nutritional state If his first opportunity to observe the patient is after conception, it is the physician's responsibility to seek out and correct any nutritional deficiencies which may be present In order to provide the patient with the opportunity for maximal health during pregnancy and lactation, she should be advised to partake of an abundantly good, varied diet and to avoid all dietary fads

A diet of the variety and quality discussed in Chapter 11, adjusted in quantity to provide the weight gain allowed by the physician, should suffice to protect the patient well during pregnancy The patient should be particularly urged to partake frequently of those foods termed 'protective foods' Milk, because of its protein content of high biologic value and its richness in both vitamins and minerals should be consumed in amounts not less than 1 quart per day Skimmed milk or nonfat milk solids may be substituted for fluid milk if caloric restriction is desired or if the economic level of the patient dictates Milk products and modified forms of milk, such as cheese, custards, buttermilk and the like, may, in part, be substituted for fluid milk

The patient should be advised to take each day at least one salad and two liberal helpings of green vegetables, one of the leafy variety, such as spinach, turnip greens, broccoli kale, and the like Fruits especially citrus fruits or tomatoes should be consumed daily A daily liberal helping of meat and four or more eggs per week are desirable Seafood may be substituted once or twice a week for meat Breads and cereals should be either of the whole grain variety or enriched

During the first trimester of pregnancy, when nausea or morning sickness is often troublesome, a small dry breakfast may be helpful If excessive hunger, sometimes to the point of nausea, occurs, between meal feedings are useful These may take the form of milk a milk drink, fruit, cheese and butter sandwiches on whole grain bread, or other nutritious snacks

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# PART II

# NUTRITION IN DISEASE

# 14

## *Deficiency Diseases*

### AVITAMINOSIS A

Critical studies of vitamin A deficiency in the human being,[1,2] both of the spontaneously occurring disease and experimentally induced avitaminosis A, have clarified our understanding of this deficiency state The clinical syndrome of avitaminosis A may manifest itself by impairment of dark adaptation, night blindness, xerophthalmia in infants the occurrence of Bitot s spots and the appearance of hyperkeratotic lesions of the extensor surfaces of the skin in adults

**Etiology** The deficiency may result from a prolonged, severe restriction of the intake of vitamin A or its precursors (the carotenoids) or from a failure to absorb these lipid soluble materials Such a failure may occur in those diseases associated with steatorrhea, such as sprue, fibrocystic disease of the pancreas celiac disease, intestinal lipodystrophy (Whipple's disease), and other syndromes Avitaminosis A is more likely to be encountered in infants than in adults, because the infant is born with relatively small stores, but has a high requirement of the vitamin for growth Accordingly, the infant is more easily depleted by a deficient diet than is the adult Storage of vitamin A in the previously well nourished adult is sufficient to maintain the adult through long periods amounting to one to three years of total abstinence from vitamin A intake[1]

**Pathology**[3,4,5] The maintenance of the normal integrity of epithelial tissues and the orderly development of skeletal structures (bones and teeth) are dependent upon adequate supplies of vitamin A Avitaminosis A results in atrophy and proliferation of the basal cells of the epithelium with metaplasia to stratified keratinized epithelium Keratinization of the cornea with superimposed infection, vascularization, and ulceration occurs in infants At one time it was stated that the most frequent cause of preventable blindness in the Orient was avitaminosis A Examination of the skin lesions reveals pigmented papules comprised of a central core of keratinized epithelium Microscopic examination of these lesions shows hyperplasia of the epithelium hyperkeratinization, and associated degeneration of the sweat glands Pathologic findings of bony overgrowth, changes in the teeth, nerve deafness and other evidences of

damage to the nervous tissues have been described in animals,[6,7] but their counterpart has not been identified in man.

**Symptoms.** The clinical findings in a subject with avitaminosis A vary with the age of the patient. Xerophthalmia and night blindness are the most frequent manifestations in infants.[8,12,13,14] Generalized dryness of the skin, or xeroderma, may be observed. Follicular hyperkeratosis,[9,10,11] however, is rare before the early adolescent changes in the pilosebaceous glands occur.

Xerophthalmia is rare in the adult; when it occurs, it is associated with the most severe cases of the deficiency. The earliest clinical manifestation of vitamin A depletion in the adult is decreased dark adaptation.[1] This may be detected by tests with any one of the several adaptometers. Later, clinical night blindness occurs. Xeroderma is followed by the appearance of follicular hyperkeratotic lesions over the posterolateral aspects of the arms and anterolateral aspects of the thighs, then extending over the buttocks, shoulders, neck, and abdomen. Similar lesions,[15] more likely limited to lower extremities and with some perifollicular petechiae, may be seen in early scurvy. It has recently been questioned whether such skin lesions are specific for avitaminosis A, and some workers hold that they are associated with B-complex deficiencies.

These skin lesions are frequently confused with the simple skin lesions of keratosis pilaris.[16] This latter condition is most frequently encountered in children before puberty, in contrast to the older age distribution of the skin lesions of vitamin A deficiency. Keratosis pilaris is unassociated with any other manifestation of avitaminosis A, with a history of satisfactory vitamin A intake and with normal blood levels of the vitamin.

The adult and, more rarely, children may exhibit Bitot's spots.[17] These are superficial, foamlike, greyish-white lesions of the conjunctiva which occur most frequently on the lateral aspect of the bulbar conjunctiva. The lesions are not to be confused with the widely occurring pingueculae seen in older adults[16,18] These latter are elevated, gelatinous-appearing, glistening, triangular lesions, usually bilaterally, and occurring first on the nasal side of the conjunctiva. Not all instances of true Bitot's spots respond to the administration of vitamin A,[19] and it is apparent that many of these lesions are due to causes other than a deficiency of this factor.

**Laboratory Diagnosis.** The excellent British study[1] of experimental vitamin A deprivation in man has demonstrated that in the adult deprived of vitamin A and carotene a rapid fall in the concentration of carotene in the serum occurs. Within a three month period the plasma levels of carotene fall to a stable concentration of some 10 to 40 I.U. (6 to 24 micrograms) per 100 milliliters. These levels are to be contrasted to the plasma concentration of well-nourished persons, which usually range between 100 and 300 I.U. (60 to 180 micrograms) per 100 milliliters. The concentration of vitamin A decreases much more slowly than does that of carotene. Indeed, in the British study, no appreciable decrease in plasma vitamin A concentration was observed until about eight months after the subjects had been on a deficient diet. Deterior-

ation of dark adaptation did not appear until the plasma level had fallen below the 50 I.U. per 100 milliliters. In the few subjects in whom clinical signs attributable to avitaminosis A appeared, these signs were consistently associated with plasma levels below 40 or 50 I.U.

These observations are consistent with those reported from China in patients with manifest vitamin A deficiency. In this series,[2] a group of healthy Chinese adults exhibited vitamin A levels ranging from 30 to 104 I.U. with a mean of 56 I.U. Eighty-five patients with clinical signs of vitamin A deficiency had carotene levels averaging 24 micrograms (range, 0 to 141) and vitamin A concentrations averaging but 6 I.U. (range 0 to 27) per 100 milliliters.

**Treatment.** The treatment of avitaminosis A consists in the correction of the pattern of dietary intake, the administration of supplementary vitamin A or carotene, and, when the disease is conditioned by steatorrhea, therapy of the underlying disease. Supplements of 5000 to 25,000 I.U. of vitamin A by mouth or its equivalent in carotene should be given daily for at least six weeks or until the lesions have disappeared. Although the lesions of avitaminosis A are slower to clear than are those of scurvy and some of the other more acute vitamin deficiencies, therapeutic failure after three months of treatment should be taken as evidence of an erroneous diagnosis. It is apparent that, in addition to these specific procedures, the proper management of the patient will include measures to combat coexisting infection, either localized or general, and the necessary supportive treatment.

### THIAMINE DEFICIENCY (BERIBERI)

The classical manifestation of thiamine deficiency is beriberi. This is a disease characterized by cardiovascular changes, often edema, and multiple neuritis. Its development is typically associated with a history of a monotonous low-protein, low-fat, high-carbohydrate diet comprised largely of a highly milled cereal, particularly rice. Most of the cases observed in the United States are associated with alcoholism. Alcoholics acquire beriberi because they have a low thiamine intake, since they tend to displace thiamine-containing foods by alcohol. In contrast to earlier beliefs, alcohol does not increase the thiamine requirement.

Beriberi is not commonly encountered in the United States. In those regions of the world where it appears, particularly the Orient and the Philippines, the disease is often a complication of pregnancy or lactation. It may even be encountered in breast-fed infants or, rarely, as a congenital disease of the newborn.

The earliest manifestations of thiamine deficiency are, indeed, extremely vague; they include mental depression, lack of initiative, irritability, easy exhaustion, digestive discomfort, and pain in the muscles. These symptoms produced experimentally were characterized by Williams and his associates[21,22] as resembling in an early stage those of neurasthenia and in a later stage those of anorexia nervosa. From their studies of experimental thiamine deficiency on a group of healthy young men, Foltz and his associates listed as outstanding symptoms anorexia, irritability, easy exhaustion and increased muscular tenderness. From

similar studies Keys and his associates[92] reported that while changes noted in objective tests were surprisingly small disorders of general behavior and obvious signs of subjective distress were impressive Somewhat different were the studies of Horwitt and his associates[93 94] which were continued for three years upon thirty six patients of the Elgin State Hospital These workers saw in both young and old a gradually increasing self imposed restriction of activity a dulling of interest and ambition a diminished desire to please and a lessened tendency to bantering and playfulness Effects were also observed on the circulation such as a non pitting swelling of the facial skin on the nervous system such as absence of patellar reflexes and increasing loss of vibration sense and on the gastrointestinal tract such as anorexia Psychotic complaints were frequent When yeast extract providing 6 mg of supplementary thiamine daily was added to the diet recovery was dramatic

In outspoken disease the most constant anatomic lesions are in the order of their frequency peripheral neuritis myocardial disease and general edema The neuritis characteristically begins in the more distal nerves involving first those of the lower and later those of the upper extremities Degeneration is usually most marked in the sciatic nerve and its branches These changes are not limited to the peripheral nerves for similar alterations have been described also in all tracts of the spinal cord especially those in the posterior columns Likewise the cranial nerves notably the phrenic and vagus nerves and also the nerves of the sympathetic system are sometimes involved There may be any degree of nerve change from a scarcely recognizable microscopic alteration to complete degeneration with disappearance of both myelin sheath and axis cylinder Vedder stated that as a rule the axis cylinder appears normal even when the medullary sheath shows marked degeneration but Shank believes that the reverse is true and that changes in the myelin sheath follow those in the axis cylinder

The cardiac disease is characterized by dilatation and hypertrophy which involves chiefly the right side of the heart and by diminished contractile powers Graphic changes in the myocardium of experimental animals have been reported by several investigators Follis and his co workers[95] found areas of focal or diffuse necrosis sometimes with scarring in pigs subsisting on a thiamine free diet The distribution of these changes suggested that the auricles were more sensitive in this respect than the ventricles This effect of thiamine deficiency on the heart muscle is apparently direct rather than through the nerves for these investigators were unable in any of their animals to find changes in the vagus or other nerves In the human subject no characteristic microscopic picture has been described

Generalized edema with serous effusions into the pericardium pleura and peritoneal cavity are common more so in the acute than in the chronic deficiencies This edema cannot be ascribed to myocardial failure for it is sometimes seen in a patient with a competent heart It is probable that the edema is not identical in origin in every case It can be said today merely that this symptom expresses a breakdown of the physiologic mechanism which controls the interchange of fluids and

preserves the water balance Other features which characterize the pathologic picture of thiamine deficiency are marked reductions in the subcutaneous and other stores of fat and degeneration of the muscles There is shrinkage of the sarcoplasm of the muscles with atrophy

Of the many clinical pictures produced by thiamine deficiency the most clearly defined is that of beriberi

**Beriberi** Beriberi is a metabolic disease due to long continued deficiency of thiamine Its most characteristic clinical features are multiple peripheral neuritis myocardial disease generalized edema with serous effusions and muscular atrophy It is an ancient disease having been described in early Chinese medical writings and has always been widespread in the Orient It is rare in the United States

*Etiology* The cause of the varied manifestations of beriberi has not been entirely clarified It is possible that more than one causative factor is operative in the production of its several forms and that it should be properly regarded as a multiple deficiency syndrome The direct relationship however between this disease and lack of thiamine is definitely established Other influences are subordinate This disease occurs only when this vitamin is lacking in the diet or when its utilization is defective and it can be cured with foods rich in this factor

It is significant as Cowgill[26] has shown that the thiamine requirement is proportional to body weight metabolism and caloric intake and that failure of the supply therefore is not the only factor responsible for the deficiency Poor absorption and faulty utilization such as occur in digestive disorders and in debilitating diseases and increased requirements such as obtain during pregnancy and hyperthyroidism will in borderline states have the same effect It is theoretically possible in such states to produce thiamine deficiency by the ingestion of foods such as raw clams or fish which contain an enzyme (thiaminase) which destroys thiamine Such foods have been shown to reduce the available thiamine of the basal diet by as much as 50 per cent[27] Beriberi is widespread in the Orient largely because a diet of polished rice supplies little or no thiamine

*Symptoms* The symptoms of beriberi are varied The clinical picture may be simple with a clear portrayal of one group of symptoms or it may have a complex and hazy outline with a mixture of diverse manifestations

According to the predominance of symptoms three chief types are recognized (1) *dry beriberi* which is characterized chiefly by multiple peripheral neuritis (2) *wet beriberi* in which general edema and serous effusions predominate and (3) *acute beriberi* which is fulminating in its course and in which cardiac failure is a salient feature Infantile beriberi belongs as a rule in this last category Mixed types are frequent

The onset in the first two types of beriberi is usually insidious At first the patient experiences easy exhaustion with pain and stiffness in the legs and tenderness in the calf muscles Loss of appetite and digestive disturbances then appear with headaches dizziness insomnia tachycardia and shortness of breath on exertion Later as an expression of the pathologic changes that are taking place more graphic symptoms of

varying types appear In the infant the onset as a rule is more abrupt

The neuritis, which in dry beriberi usually dominates the picture, begins insidiously and expresses itself at first by easy fatigue The patient can walk only a short distance before his legs give out Associated with this symptom are acute tenderness on pressure in the calf muscles and numbness in the feet and ankles, with a burning sensation in the soles Beginning in a symmetric manner in the distal parts the neuritis gradually ascends, and muscle weakness becomes more extensive As involvement of the lower extremities, first of the calf and then of the extensor muscles, becomes pronounced, that of the upper extremities begins Toe drop and foot drop occur early, and later wrist drop Involvement of the muscles of the trunk occurs late The sphincters are usually spared The deep tendon reflexes are at first accentuated and then lost Ataxia and loss of coordination occur Atrophy of the muscles, possibly with contractures, and atrophy of the skin are late manifestations

Parallel with the motor impairment, sensory changes occur—first hyperesthesia and then anesthesia The patient may become helpless and bedridden Mental impairment is rare The neuritis is seldom the cause of death, which as a rule is due to heart failure

The myocardial changes, which are most pronounced in acute beriberi, may pursue a fulminating course and lead to acute cardiac failure [28] Cardiorespiratory symptoms may be the first and practically the only manifestations of this type of the disease, or they may suddenly appear later, during the course of the dry or the wet beriberi There is often dyspnea, with precordial pain, cyanosis and a rapid, thready pulse On examination, marked cardiac hypertrophy, especially of the right side, is found This type of cardiac hypertrophy is believed to be peculiar to beriberi, but apparently it is not characteristic of the beriberi heart as seen in the United States, and first described by Weiss and Wilkins [29] The latter disorder is believed today to have no distinctive pathologic change and to present no peculiarly characteristic clinical picture Blankenhorn and his associates[30] have reported twelve cases recognized in the Cincinnati General Hospital in five years, an incidence of 0 1 per cent They do not regard the originally described criteria of acceleration of the circulation and enlargement of the right side of the heart as predominating features, and offer the following conditions for the recognition of this form of myocardial failure (1) insufficient evidence for other cause, (2) three or four months on a thiamine deficient diet, (3) signs of neuritis or pellagra, (4) enlarged heart with sinus rhythm, (5) dependent edema, (6) elevated venous pressure, (7) minor electrocardiographic changes and (8) recovery with decrease in heart size or autopsy findings consistent with beriberi heart disease

Edema and serous effusions are seen chiefly in wet beriberi, although they may occur during the course of the dry type of the disease Beginning in the lower extremities, the edema gradually involves the rest of the body, including the pleural and peritoneal cavities and the pericardium The face is rarely involved Apparently the edema is independent of the kidneys and of the state of the heart

Anorexia and other evidences of gastrointestinal disorder are common in all types of beriberi Accompanying the anorexia which is one of the first symptoms to appear are manifold disturbances of tone and motility as well as of secretion Diarrhea and vomiting are frequent in wet beriberi but may occur also in the dry variety

Beriberi was prevalent among the allied soldiers confined in Japanese prison camps The American officers Lewis and Musselman[31] saw evidences of this disease among a large proportion of the men under their care and found it difficult at times to distinguish between thiamine deficiency and disease due to lack of niacin or other essentials Similar reports came from British physicians Dancy Browning and Rich[32] called attention to the failing vision of many of their patients and attributed it to a retrobulbar neuritis

The infantile type is nearly always acute and may be rapidly fatal Williams and Spies[33] state that it is characterized chiefly by constipation diminution in the volume of the urine rigidity of the body weakness edema cyanosis a peculiar whine irritability and tachycardia and that there is prompt response to adequate treatment A case of severe congenital beriberi in an infant born to a mother who had lived on a grossly deficient diet has been reported by Van Gelder and F U Darby[34]

*Alcoholic neuritis* was believed to be due to the neurotoxic effect of alcohol until Shattuck in 1929 suggested that the fault might lie in a dietary deficiency Minot the following year expressing similar views emphasized the value of high vitamin diets Reports in support of the latter view were made by other authors and in 1933 Minot Strauss and Cobb publishing their studies on patients with alcoholic polyneuritis told of the striking results obtained with abundant diets supplemented with cod liver oil and autolyzed yeast They attributed the disease to inadequate diet especially as regards vitamin $B_1$ and called attention to its similarity to beriberi In explaining this condition Jolliffe Colbert and Joffe made use of Cowgill s formula to show that the calories received from the large amounts of alcohol consumed by old imbibers so upset the Calory vitamin $B_1$ ratio of safety as to produce relative hypovitaminosis and eventually polyneuritis Similar observations were made by Spies and Blankenhorn in their studies of alcoholic neuritis both in pellagrins and in patients without pellagra and also by Strauss[35] in his studies of alcoholic polyneuritis without pellagra In these studies it was found that even though the person continued to consume his accustomed amounts of alcohol the neuritis could nonetheless be cured by an adequate diet particularly when large amounts of yeast or liver extract were added

*Korsakoff's syndrome* of confusion loss of memory and irresponsibility seen in old alcoholic addicts is now regarded as probably due to nutritive deficiency more particularly to a lack of thiamine but clear evidence in this regard is lacking

*Wernicke s disease* characterized clinically by ophthalmoplegia polyneuropathy ataxia and mental confusion is usually associated with multiple vitamin deficiency but Alexander has seen in pigeons with pure thiamine deficiency the identical minute hemorrhages in the nuclei

around the ventricles which have been reported in this disease in man Jolliffe[36] inclines to the view however that this disease is due to multiple nutritive deficiencies

The *neuritis of cachexia and of senility* also may be due to lack of thiamine there is much to suggest such a relationship

*Diagnosis* Particularly in the dry form of beriberi the diagnosis is relatively easy but the recognition of atypical borderline disorders due to lack of this vitamin especially those of mixed origin involves difficulties The promptness with which the manifestations of thiamine deficiency disappear when the missing substance is given in adequate amounts is of signal diagnostic help Of great importance too is a knowledge of the patient s history and of his environment and habits

The differentiation of neuritis due to lack of thiamine from neuritis of other origin is usually not difficult Unexplained peripheral neuritis should always lead to inquiry as to the adequacy of the diet The tenderness of the calf muscles and the areas of anesthesia over the anterior surface of the tibia to which Vedder[37] called attention are diagnostic signs of value Arsenic may produce neuritis that is difficult to distinguish from that of beriberi but in the former type of injury the sensory changes predominate and the disease is as a rule acute rather than chronic In lead poisoning only the motor nerves are as a rule affected and involvement of the upper extremities is more frequent pain is rare Infectious polyneuritis usually begins elsewhere and spreads to the periphery the cranial nerves notably the seventh nerve are more often attacked Jolliffe[36] states that the polyneuropathies of thiamine deficiency are bilateral and symmetrical and characteristically involve first and predominantly the lower extremities The criteria by which the beriberi heart can be identified were given on page 256

Infantile beriberi can usually be recognized through the association of the symptoms given on page 257

For the determination of thiamine in the body fluids several procedures have been devised the oxidation of thiamine to *thiochrome* and its measurement by fluorescence yeast fermentation and *biologic* assay

Such measurements however are not generally useful as routine diagnostic aids since thiamine levels *in blood and urine do not* seem to be precisely related to clinical findings Although lacking in specificity blood pyruvate determinations are probably more adaptable to general laboratory use Since the decarboxylation of pyruvic acid is dependent *upon the thiaminoprotein enzyme* a lack of thiamine results in an elevation of pyruvic acid levels in the blood A number of other conditions are likewise associated with an elevation of pyruvic acid levels Accordingly this determination is not a specific indicator of thiamine lack

A more promisingly useful diagnostic tool is the carbohydrate metabolic index (CMI) proposed by Horwitt and Kreisler[38] This test is based on the fact that the rate of disposal of pyruvic acid depends upon the metabolic load of glucose and lactic acid Hence simultaneous determination of these three constituents (pyruvic acid glucose *lactic*

acid) in blood is carried out and the values related The procedure is as follows 9 milliliters of 20 per cent glucose per kilogram of body weight are administered orally after a fasting blood sample has been withdrawn A mild exercise test is applied sixty minutes later The exercise consists in walking up and down and up and down again a flight of twenty one steps 19 cm high within a period of sixty seconds Five minutes later another blood sample is taken The empirical formula

$$\text{CMI} = \frac{L - \frac{C}{10} + 15P - \frac{G}{10}}{2}$$

is applied G L and P respectively represent levels of glucose lactic acid and pyruvic acid in milligrams per 100 milliliters of blood Horwitt and Kreisler set 15 as the upper normal limit of the value of CMI This figure was never surpassed by subjects on an adequate diet and was invariably surpassed by those whom they maintained on a regimen grossly deficient in thiamine It is apparent that this test would have its limitations in application to patients with definite cardiac impairment It should however prove of value in establishing the diagnosis of thiamine deficiency in relatively mild cases

*Prognosis* The outlook in all disorders due to lack of thiamine depends upon prompt recognition especially in cases of acute involvement and the administration of adequate amounts of the vitamin or of foods rich in this factor In cases of acute and infantile beriberi and in the chronic disease if the damage to the nervous system is not too great response to treatment is as a rule good Often the improvement is graphic In acute heart failure however the outlook is grave

*Treatment* The cure of the dietary disorders that have just been discussed can be accomplished by the prompt and liberal use of thiamine either as food or in the crystalline form The disorders in which the therapeutic use of this vitamin is clearly of value or in which the similarity of pathologic conditions is such as to encourage its tentative use include the following (1) beriberi (2) the polyneuritis of chronic alcoholism (3) other forms of polyneuritis of more doubtful origin such as that of cachexia and senility (4) hunger edema and edema accompanying obscure diseases (5) cardiac failure of obscure origin with hypertrophy and (6) functional disorders of the gastrointestinal tract featured largely by anorexia and disturbances of tone and motility

The similarity of symptomatology of the early stages of thiamine deficiency to anxiety states and functional disturbances has led to much abuse of the use of thiamine in therapy As Ruffin[39] aptly stated

One must not lose sight of the fact that many maladjusted and neurasthenic persons have a coexisting mild vitamin deficiency It is important of course to correct this deficiency by diet if possible supplemented by vitamins if necessary It is equally important to realize that vitamins are not the panacea of all ills that they afford little relief in social financial or domestic problems that long continued treatment with expensive vitamins is a serious and unnecessary drain on the patient s pocketbook and that in the last analysis a well balanced diet

is the best treatment in most of the cases of mild vitamin deficiencies The diet should be abundant and include meat, peas, beans whole cereals, liver, fresh vegetables, and other foods which are dependable sources of thiamine

Thiamine may be administered orally or parenterally When given orally, the dosage should be 3 to 5 mg two or three times a day Oral doses larger than 5 mg are not more efficient, owing to limitations of absorption Parenterally, the vitamin may be given in doses of 5 to 25 mg daily The oral route is preferable except in critical cases Other dietary supplements may be substituted for pure thiamine Useful sources of thiamine include Brewer s yeast, wheat germ, and tikitiki (alcoholic extract of rice polishings) The treatment of infantile beri beri consists in administering 5 to 10 mg of thiamine parenterally once or twice a day and in correction of the dietary defect

## RIBOFLAVIN DEFICIENCY (ARIBOFLAVINOSIS)

Riboflavin deficiency is often associated with pellagra and indeed was early considered to be a part of the pellagra syndrome The first recognition of ariboflavinosis as a distinct entity was by Sebrell and Butler,[40] who observed cheilosis in subjects rendered deficient in riboflavin

The mucosa of the lips exactly in the angle of the mouth, shows first pallor and then superficial transverse fissures usually bilateral The fissures extend somewhat downward from the angle and there is little inflammatory reaction There may occur redness of the lips with desquamation along the line of closure Fissures may also be seen at the commissure of the eyelids and at the nasal orifices These signs are a part of the picture of riboflavin deficiency, but alone are not diagnostic of ariboflavinosis If looked for, these signs will be found with great frequency in malnourished persons, notably in children Many years ago cheilosis was referred to in mountainous regions as ' poor folks mouth The color of the tongue has been held to be particularly characteristic, the normal pink is replaced by a purplish red or magenta which according to some, can be distinguished from the scarlet red of niacin deficiency These color changes, however, are no longer regarded as characteristic

Evidence of this lack of specificity[18] is seen in reports that the lesions of cheilosis may heal after the administration of niacin pyridoxine or pantothenic acid conversely, instances have been reported in which such lesions were refractory to all treatment with the B vitamins Cheilosis and superficial glossitis may be associated with the anemia of iron deficiency and respond only to the administration of iron [41] Pseudo-ariboflavinosis of Ellenberg and Pollack[42] is fissuring at the angles of the mouth of older persons as a result of ill fitting dentures It does not respond to treatment with riboflavin

Another sign formerly supposed to be characteristic of riboflavin deficiency is the sprouting of the capillaries from the limbic plexus into an otherwise normal cornea, giving a superficial vascularization of this structure Sydenstricker[43] states that there appears first a slight circumcorneal congestion, frequently visible with a hand lens or oph

thalmoscope before it can be seen with the unaided eye In such cases the slit lamp shows proliferation and marked congestion of the limbic plexus there are many newly formed capillaries which obliterate the normal avascular zone between the plexus and the sclerocorneal junction A little later sprouts of capillaries at first empty and later containing red blood cells can be seen growing in the cornea Tisdall and his associates[44] reported ocular changes of this sort in 197 of 198 Royal Air Force personnel which they regarded as evidence of aribo flavinosis

Other observers however are inclined to regard these changes merely as evidences of simple congestion of the vessels about the cornea[16] such as may take place in any form of inflammation Mann[45] believes that this difference of opinion is due in part to a failure of writers to distinguish between simple congestion in this area in its several forms and actual budding out of new capillaries onto the true cornea She describes such a case which viewed with the critical eye of the ophthal mologist she regards as representing true ocular ariboflavinosis Cur rent opinion was expressed by Lowry and Bessey[46] when recognizing that in man just as in experimental animals a deficiency of riboflavin may lead to an invasion of the cornea by capillaries they concluded with the advice that these changes can be induced by such a variety of agents that there is need for caution in the interpretation of corneal vasculari zation in man Darby[16] has pointed out that while this sign alone gives no useful information as to the prevalence of riboflavin deficiency in a population it is useful as *one* of the group of signs to be considered in *arriving at a diagnosis of ariboflavinosis in individuals*

Congenital malformations have been described in the offspring of female rats reared and bred on a ration poor in riboflavin[47] but no such effects have been reported in man Likewise changes in nerve structure are rather constant features of this deficiency in experimental animals but have not been described in man

The usefulness of laboratory assessment of riboflavin deficiency by measurement of urinary excretion over a twenty four hour period or following a load test or by estimation of blood levels is still to be defined

**Treatment** The treatment of ariboflavinosis consists in the provision of a liberal diet containing generous quantities of the foods rich in riboflavin (milk meat organ meats leafy vegetables) coupled with the supplementary administration of riboflavin either as crystalline ma terial or as dietary supplements rich in this factor Especially useful in the latter category are Brewer s yeast powdered milk and defatted wheat germ

The oral route of administration of riboflavin is more efficient than the parenteral route because of the rapid excretion of parenterally ad ministered vitamin Furthermore smaller doses of the factor given be fore meals appear to be more completely retained than larger doses administered in the fasting state Three doses daily of 2 to 5 mg of riboflavin at meal time is a satisfactory schedule of treatment Simul taneously the patient should receive therapy for other recognized co existing deficiencies As previously indicated niacin deficiency is com monly seen in conjunction with ariboflavinosis

## PELLAGRA

Pellagra is a nutritional disorder the chief manifestations of which are in the skin and mucous membranes, digestive tract and nervous system For a century or more pellagra has been endemic in Italy and Spain and, though less frequent, has occurred also in other European countries It is now believed to have been epidemic in the military prisons of this country during the Civil War, but its true nature was not recognized, it was not until 1907 that its prevalence in the southern part of the United States was recognized and reported by Searcy[48] About that time it spread rapidly over the entire South and assumed almost epidemic proportions A few years later both the incidence of the disease and its mortality rate fell Beginning in 1939 and 1940, the disease showed a pronounced decline throughout the registration area of the United States and by 1945 had nearly disappeared It is now a rare disease in the United States, although it continues prevalent in many of the areas of the world in which corn constitutes the major food item Why did pellagra appear in the southern states with relative suddenness in 1906? Why did it disappear some 10 or 12 years ago? These are questions which have no simple answer, but they are related to the many forces in the economic development of a people

*Etiology.* The cause of pellagra is nutritive deficiency This deficiency may be relative or absolute, the result of a faulty diet or of poor absorption from the intestinal tract. The identity of the missing substance or substances has been much studied Goldberger and his associates[49] in the United States Public Health Service, after their studies on a Mississippi prison farm, postulated a substance which they termed the pellagra preventive or P P factor and which they assumed was lacking in the pellagra producing diet After this, many attempts were made to purify and identify this factor Notable work was done by Chittenden and Underhill and subsequently by Underhill and Mendel,[50] who, by using diets similar to the pellagra producing diets of human beings, were able to produce experimental black tongue in dogs and to demonstrate that this disease is similar to if not actually identical with human pellagra A few years later Elvehjem and his associates[51] succeeded in curing black tongue with nicotinic acid, and soon there appeared other reports from three different clinics, each bearing testimony as to its curative value in human pellagra [52 53 54]

The belief of the older writers that pellagra was produced by the eating of corn is now finding a basis in experimental fact Krehl and his associates[55] observed that corn exerts a retardation in the growth of rats, which effect can be nullified by nicotinic acid These discoveries were clarified considerably when the same group of workers demonstrated that these effects of corn can be counteracted and the need for additional niacin replaced by the addition of tryptophan to the diet Corn is poor in this amino acid The earlier explanation[56] of this relationship on the assumption that corn retards the growth of niacin synthesizing microorganisms in the intestines and that the addition of tryptophan (or protein) may have an opposite effect on these microorganisms has been

replaced with the established theory that tryptophan serves as a precursor of niacin [57, 58, 59] It is still an open question whether corn contains an important pellagragenic principle [60] Whatever the explanation it is apparent that Casal who in 1735 formulated the maize theory of pellagra was an accurate observer

There remains however one insistent question Can this disease be attributed to a single nutritive fault? Probably not On the basis of clinical experience McLester[61] reached the conclusion a number of years ago that pellagra is due to the lack of two or more essential substances subsequently Ruffin and his associates [62] after their success in the use of liver fractions in the treatment of this disease expressed a similar view Accumulating evidence would indicate that while lack of niacin dominates the picture pellagra is in truth a disease of multiple deficiencies niacin protein riboflavin and perhaps hemopoietic factors

**Symptoms** The symptoms of pellagra fall into four groups cutaneous mucosal intestinal and nervous The cutaneous manifestations may appear on all exposed parts but are most pronounced on the backs of the hands on the forearms on the forehead and in the perineal region Lesions in the form of a collar or necklace are frequent There is first a simple erythema which soon becomes a dermatitis varying in the severity of its manifestations from slight pigmentation to severely cracked and ulcerated secondarily infected areas The lesions are so definitely symmetric as to suggest a nervous origin They are made much worse by irritation whether from mechanical injury or from sunlight

The mouth is sore and is often cracked at the corners the tongue becomes violently red Secondary infections with Vincent s organism is common The mucous membranes of the nose throat vagina anus and rectum may also be inflamed The entire gastrointestinal tract is involved as is evidenced by lowered gastric acidity and diarrhea and frequently by vomiting Constipation may be a symptom in the cases of milder involvement A burning sensation in the abdomen is common

Nervous symptoms are common and sometimes dominate the picture Among them are malaise irritability anxiety vague neuroses and delirium Acute mania supervenes in the cases of more violent disorder Jolliffe and his associates[36] have described a syndrome characterized by sucking and grasping reflexes changing cog wheel rigidities and progressive cloudiness of the consciousness to which they gave the name nicotinic acid deficiency encephalopathy This syndrome is frequently seen in association with chronic alcoholism and with cirrhosis of the liver Sydenstricker and Cleckley[63] also tell of patients with lethargy stupor disorientation and hallucination who were relieved by the administration of nicotinic acid As the disease progresses loss of reflexes ataxia and other evidences of degeneration of the spinal cord appear

Revealing pictures of pellagra were drawn by Medical Officers serving with the United States troops in Japanese war camps Lewis and Musselman[31] tell of the dramatic suddenness with which pellagra appeared about four months after the surrender at Bataan 500 out of 5000 men suddenly presented signs and symptoms of the disease The

skin lesions were similar to but more extensive than those usually described as pellagrous, these lesions appeared on parts of the body exposed to the sun and were aggravated by sunlight The integrity of the skin was impaired, and the slightest trauma would result in infection with ulcer formation Dermatitis of the scrotum was often an early symptom Cheilosis was pronounced, and the tongue was raw, swollen and fiery red Similar changes were seen in the pharynx and palate

Many patients with mild clinical pellagra complained of various digestive disturbances postprandial epigastric discomfort, flatulence, pyrosis and foul "yeasty' eructations The free hydrochloric acid was reduced or absent from the stomach contents of many of the patients and Lewis and Musselman gathered the impression that impairment of gastric secretion was a part of the pellagra syndrome

Personality changes with irritability, moodiness, loss of memory and inability to concentrate were frequent A few patients became disoriented and delirious Neurologic symptoms were common These consisted in numbness and tingling, decreased sensation to light and deep touch, and loss of position sense Some of the patients showed paresis foot drop and impairment of deep reflexes, others exhibited spasticity and exaggerated reflexes

Similar disturbances were described in other war camps by the English physicians Clarke and Sneddon,[64] who emphasized the prevalence and distressing nature of "electric" or 'jumping feet , there were a burning sensation and extreme hyperesthesia of the balls of the feet Beriberi and other forms of nutritive failure as well as pellagra were prevalent among these prisoners, and the writers state that the effects of niacin, thiamine or other forms of nutritive deficiency were not always distinguishable This is equally true of the beriberi and pellagra seen in the United States

Improvement during the winter months with relapses of increasing severity each successive summer is the rule in the pellagra as it occurred in the southern United States The seasonal occurrence of pellagra in the springtime has been related to the increased amount of sunlight at that season of the year

*Pellagra in children* conforms as a rule to that seen in adults and is not uncommon The term "infantile pellagra" has been used by Gillman and Gillman[65] to designate a syndrome which differs from ordinary pellagra This is a disease in non European children in South Africa with a high death rate They report twenty three cases showing varying degrees of edema dermatitis cheilosis alopecia, steatorrhea and fatty liver and emphasize the significance of the last two symptoms Their experience leads them to the belief that although this disease is initiated by dietary imbalance, the secondary pathologic changes which eventually supervene cannot be alleviated by a full diet with vitamins They place some value on liver extract but through the administration of powdered stomach (10 gm daily) to their patients they accomplished "dramatic improvement" (See the discussion of Kwashiorkor p 272)

**Pathology.** The pathologic picture of pellagra is not specific Marked emaciation is a salient feature The most typical lesions are those of the

mouth and skin The latter vary from simple erythema to violent inflammation and ulceration The intestinal wall often shows in certain parts swelling redness and ulceration and in others complete atrophy The spinal cord may show areas of degeneration these involve most often the posterior and lateral columns

**Diagnosis** The diagnosis of pellagra is made as a rule upon the basis of the mucosal and cutaneous lesions Most characteristic are the violently red tongue the stomatitis and the lesions at the corners of the mouth

The dietary history usually reveals a high intake of corn and a diet low in lean meat milk and other protective foods

Chemical tests designed for the appraisal of niacin nutriture include estimations of the urinary excretion of nicotinic acid N methylnicotinamide and of N methyl 6-pyridone 3 carboxylamide The tests are all far from a satisfactory state for clinical use The measurement of N methylnicotinamide excretion in a sample of urine collected four hours after an oral test dose of 50 mg of niacinamide offers some usefulness [66]

**Treatment** The treatment of pellagra can be divided into three categories (*a*) dietetic (*b*) specific and (*c*) general

The *dietetic treatment* of this disease was greatly elaborated by Spies Chinn and McLester[67] through their studies in Cincinnati and Birmingham In their original study of fifty cases of severe pellagra in Birmingham they were able through improvement in the Goldberger type of diet and by insistence upon rigidity of control to reduce the mortality from a previous 32 to 7 per cent This was before the value of nicotinic acid was known The diet was of unusually high caloric value providing as a rule about 4500 Calories Since the discovery however of the value of niacin and of good protein such abundance in diet is not necessary It is sufficient today to give a balanced diet containing 100 to 150 gm of good protein together with carbohydrate and fat sufficient to provide about 3500 Calories daily The protein should be largely in the form of meat milk eggs and perhaps yeast Because of the irritability of the alimentary tract roughage should be limited at first but as the patient improves fruits and green vegetables may be added in fairly liberal amounts

The *specific treatment* consists in giving adequate amounts of nicotinic acid or preferably nicotinic acid amide and of yeast Nicotinic acid or the amide is easily taken by mouth and is quickly absorbed It is preferably given in this manner for even in the presence of violent stomatitis and gastritis it is promptly utilized If necessary however it can be given intramuscularly or intravenously The usual dose is 150 to 500 mg daily given in three doses although a smaller amount will suffice As much as 1 gm has been administered orally in one dose without untoward results If nicotinic acid amide is given the flushing and burning sometimes produced by nicotinic acid can be avoided For intravenous use the dose of the drug is 10 to 20 mg given four times daily To avoid untoward symptoms ten minutes or more should be allowed for the administration of 20 mg

The results of the administration of nicotinic acid are sometimes amazing There is prompt blanching of the skin and of the mucous

membranes the lesions rapidly disappear and the diarrhea promptly subsides The highly excited perhaps delirious patient becomes within twenty four or thirty six hours calm and collected and the patient who has been apathetic begins to manifest an interest in his surroundings

Yeast is also of great value but it should be given in what may be regarded as enormous doses We have found it of advantage in severely ill pellagrins to give 180 to 270 gm of powdered brewer s yeast daily This is best tolerated when given in iced milk or eggnogg in doses of about 20 gm each The yeast will usually relieve the neuritis but thiamine also may be given in doses of 5 to 10 mg daily

Liver extract given intramuscularly or intravenously was used before the value of nicotinic acid became known It is still used to advantage particularly for those patients who have neuritis It may be that the value of liver extract in pellagra lies in its content of vitamin $B_{12}$ which vitamin has been dramatically useful in relieving some cases of alcoholic neuritis [68]

General measures are of importance Every pellagrin should be kept in bed until convalescence is well established in order to accomplish this it may be necessary to administer large doses of phenobarbital or other sedatives Since the cutaneous symptoms promptly disappear after the use of nicotinic acid these as a rule require little thought Applications of solution of potassium permanganate (1 5000) have been used with benefit The diarrhea is difficult to control until the patient begins to improve when it usually subsides promptly Extremely severe diarrhea and abdominal pain can best be controlled with tincture of opium

**Literature** The literature dealing with pellagra is abundant The reader will find especially useful the reviews of Elvehjem[63a] and Sydenstricker[63a] dealing with the relation of nicotinic acid to pellagra the clinical papers of Sydenstricker[63] and Jolliffe [36] and the more recent description of pellagra among prisoners of war by Lewis and Musselman [31] and by Clarke and Sneddon [64] Evidence bearing on the etiology of the disease has been reviewed by Handler[69] and by Harriette Chick [70]

## SCURVY (VITAMIN C DEFICIENCY)

Scurvy a disease caused by the lack of vitamin C is probably the deficiency disease earliest known to the western world An early description of scurvy is that of de Joinville who accompanied the crusaders at the time of their invasion of Egypt under St Lewis [71] Throughout the centuries it has received much attention because it has been a plague of armies navies and other expeditions on which man has been totally dependent upon stored foods Indeed the conquest of scurvy has represented a triumph over disease of food processing storage *and distribution*

Scurvy is characterized by the failure of deposition of the intercellular substances collagen osteoid and dentine Clinically this is manifest by hemorrhagic tendencies

**Occurrence** Scurvy is a dietary deficiency disease Conditioning factors are usually those which result in abstinence from foods containing

vitamin C For example, psychiatric abnormalities may bring on greatly restrictive food habits The presence of a peptic ulcer sometimes influences the selection of foods in a manner that one avoids those containing vitamin C, indeed the earlier use of the strict Sippy regimen in the treatment of peptic ulcer represented an induced vitamin C deficient diet when the milk used was heat treated

Scurvy seldom, if ever, occurs in breast fed infants Failure to supplement a milk formula with sources of ascorbic acid is the common cause of infantile scurvy Simple dietary deficiency of vitamin C in adults is met with most commonly in those who live alone, such as widowers or bachelors, hence, the term 'bachelor's scurvy" In the United States the disease is infrequently encountered but it cannot be classified as a rare condition [72,73] Within a period of a year, it is an exceptional medical or pediatric service which, if alerted, does not encounter at least a single case of mild scurvy

**Pathologic Picture** [74] The pathologic picture of this disease and all its manifestations is dependent upon failure of the one clearly established function of ascorbic acid, that of controlling the formation of intercellular material Defective collagen formation accounts for impairment of wound healing [75] The abnormal fragility of the bones is related to the defect in osteoid formation and resulting impairment of calcification

The most striking manifestation of scurvy is hemorrhage, which may occur from almost any organ In mild cases it is manifest at sites of trauma, for example, in the infant in the diaper region In the adult, petechiae are first seen below the knees and are perifollicular in their distribution In severe cases, one may encounter hemorrhage into the joints subperiosteal hematomas in infants, or massive ecchymotic areas

Changes in the gums occur early in the disease, but are present only in patients with teeth Pre existing gingival infection seems to aggravate the lesions due to scurvy [76,77] The earliest signs in this area are small hemorrhages at the tips of the interdental papillae The interdental papillae then show swelling, redness additional hemorrhage, and purplish discoloration Gross infection may be evident, and in severe cases loosening of the teeth occurs

Bone changes are most evident in the growing subject These alterations include impairment in the formation of cartilage and of the bone matrix and marked alterations in the epiphyses with severance of the epiphyses and the diaphysis The resulting fibrous union between epiphyses and diaphysis may be recognized in the roentgenogram Scorbutic beading of the ribs at the costochondral junction is common in infantile scurvy Subperiosteal hemorrhage may be encountered

The location of these lesions is influenced largely by growth and mechanical stress The osseous changes occur in bones which are still growing and the hemorrhages take place in those regions most subject to stress and trauma

**Clinical Picture.** The clinical picture of scurvy is different in the infant from that in the adult The scorbutic infant is usually five to twelve months of age and appears somewhat anxious and often slightly pale If subperiosteal hemorrhage has occurred the position assumed is

characteristic The infant is on his back with one or both thighs slightly flexed and abducted This constitutes the so called 'frog position' In anticipation of the pain of handling, the infant cries as the examiner approaches the bed Swelling of one or more joints may be observed, usually the knees or ankles Petechiae in the diaper region or elsewhere at the site of bindings or trauma may be seen Costochondral beading and, if dentition be present, swollen red gums complete the picture

Roentgenologic examination may reveal evidences of subperiosteal hemorrhage, of separation of the epiphyses, and of the so called 'white line of Frankel"—a white, somewhat irregular transverse band most often seen at the lower end of the radius or femur

Chemical determination of the concentration of ascorbic acid in the blood plasma or serum reveals the complete absence of this vitamin in untreated cases of scurvy The presence of significant quantities of vitamin C in the plasma should be taken as evidence either of previous treatment of the infant in the immediate past or of a mistaken diagnosis

The 'livid spots and putrid gums" of the older writers are seldom encountered in their extremely severe grades today in adults Because of the excellent observations[75 76 79] on experimentally induced scurvy in the adult, we now have a clear picture of earliest manifestations of the disease The initial changes are the appearance over the extremities buttocks, and back of enlarged hair follicles plugged with horny material These follicles then become red because of congestion and proliferation of the blood vessels around the follicle This corresponds to what has been termed 'folliculitis" of some writers The red color may then become permanent, failing to disappear upon pressure, assume a purplish hue, and be associated with recognizable petechiae With the appearance of petechiae in the lower extremities, small hemorrhages and swelling of the interdental papillae are evident These gum changes then proceed to the swollen red to purplish gingivae, which bleed upon the slightest trauma

The occurrence of anemia specifically due to vitamin C deficiency has long been debated Scorbutic infants may exhibit microcytic hypochromic anemia of iron deficiency and, in some instances a megaloblastic anemia Indeed, recently accumulating evidence for an interrelationship between vitamin C and folic acid and citrovorum factor indicates that some cases of megaloblastic anemia are conditioned by vitamin C deficiency[80] It appears justifiable to conclude therefore that scurvy may be associated with anemia in infants and that the anemia may, if it be megaloblastic, be contributed to by the vitamin C deficiency itself Many cases of scurvy in infants exhibit no anemia

Among scorbutic adults, however, some 30 to 90 per cent exhibit appreciable degrees of anemia[73] This anemia may be normochromic and normocytic or slightly macrocytic Hospitalization of such patients and treatment of the scurvy with vitamin C are followed by a slow disappearance of the anemia without reticulocytosis[73] Again, the interrelationships between vitamin C and the newer hemopoietic vitamins undoubtedly account for the development of much of this anemia On

the other hand certain cases of scurvy exhibit microcytic hypochromic anemia which is presumably due to iron deficiency

**Biochemical Changes in Scurvy** Studies of experimental human scurvy demonstrate that the plasma vitamin C level falls to a negligible level within a period of six weeks to three months after a subject is placed on a diet totally devoid of ascorbic acid [75 76 79 81] As the plasma ascorbic acid decreases there occurs a more gradual fall in the concentration of the vitamin in the white cell platelet layer After some five or six months of depletion the vitamin disappears from this site and shortly thereafter the earliest manifestations of follicular changes and impairment of wound healing appear Critically studied cases of untreated scurvy invariably reveal an absence of ascorbic acid from the plasma or serum and where white cell platelet levels have been estimated these are exceedingly low

It is apparent therefore that the presence of significant amounts of vitamin C in the plasma is evidence against the presence of scurvy [82] On the other hand a plasma concentration of zero does not enable one to make a definite diagnosis of the clinical disease In the Vanderbilt University Hospital we have found that diagnosis in suspected cases with zero plasma vitamin C levels is greatly aided by application of vitamin C saturation tests In infants a test devised by Kajdi and co-workers[83] is useful This test is as follows After fasting blood for an ascorbic acid determination is taken Two hundred milligrams of ascorbic acid in saline solution are injected intramuscularly Four hours later a second sample of blood is taken and analyzed A rise in plasma concentration to less than 0 2 mg per 100 cc is good evidence of scurvy An increase to less than 0 6 mg at the four hour period may be considered to indicate unsaturation with ascorbic acid If however the rise be above 0 2 the diagnosis of scurvy is exceedingly unlikely

A similar test of value for adults is that described by Wolfer Farmer Carroll and Manshardt [75] This consists in the oral administration of 15 mg of ascorbic acid per kilogram of body weight and the determination of the plasma ascorbic acid level at fasting two three four and five hours after the vitamin C is given The maximum rise consistent with the diagnosis of clinically manifest scurvy is 0 4 mg per 100 cc In our hands these tests have proved more convenient for the diagnosis of individual cases than have estimations of white cell vitamin C

As was discussed in Chapter 5 ascorbic acid deficiency results in a decreased ability of the organism to metabolize large quantities of the aromatic amino acids These defects have been demonstrated in scurvy both in infants[84 84a] and adults [85] but no useful diagnostic test has been devised based upon these procedures

**Treatment** In the British study[76] of experimental scurvy extremely small doses of vitamin C were found to cause the disappearance of the early clinical manifestations A gradual disappearance of the signs followed the administration of 10 mg of the vitamin per day Those with experience in treating the disease will recognize that these subjects did not exhibit the dramatic response so characteristic of patients treated with adequate doses of 300 mg of vitamin C per day Nevertheless it

is obvious that wide ranges of vitamin C do suffice to induce remissions in scurvy. Repeated demonstrations show that complete saturation of the tissues of the adult scorbutic requires between 3 and 4 gm of ascorbic acid. Therefore, it is not unreasonable to plan therapy to provide such amounts within a relatively brief time. This may be accomplished by giving oral doses of vitamin C in amounts of 300 to 1000 mg daily for four to ten days. Simultaneously, the diet should be corrected to include quantities of the dependable sources of ascorbic acid. These include fruits (especially citrus), tomatoes, green leafy vegetables, and raw vegetables. Permanent cure of scurvy is obtained only by correction of the poor dietary pattern responsible for the development of the disease.

The prevention of ascorbic acid deficiency lies in the early administration of dietary sources of the vitamin to infants. Its prevention in the adult resides in dietary education and the correction of social factors which contribute to the dietary pattern characteristic of the subject who acquires bachelor's scurvy.

### RICKETS (VITAMIN D DEFICIENCY)

Rickets is a developmental disease of bones manifest by defects in calcification that lead eventually to skeletal deformities. It can be prevented or cured with vitamin D. The bone changes of rickets and osteomalacia (adult rickets) may occur from a great variety of causes.[86] We shall concern ourselves here, however, with those changes which can be prevented or cured with vitamin D at the usual physiologic level.

Rickets is primarily a disease of the temperate zone and most often occurs in children under three years of age. The severe forms of the disease with its remarkable body deformities have practically disappeared in the United States within recent years. That vitamin D deficiency may still be present in a mild form is implied in a study of the autopsies of children who died in the Johns Hopkins Hospital during a fourteen year period ending in 1942. Pathologic examinations revealed some degree of rachitic change in 46 per cent of these autopsies.[74] It is apparent that such a study does not permit differentiation between rachitic changes due to avitaminosis D and other causes of indistinguishable pathologic changes in the bone.

In order that vitamin D-deficient rickets develop, the diet must be deficient in the preformed vitamin and the patient must not have been exposed to appreciable quantities of ultraviolet light of the wavelength which will convert 7-dehydrocholesterol into the active vitamin. It has long been recognized that exposure to ultraviolet irradiation has antirachitic properties.[87]

**Pathologic Physiology.** In vitamin D-deficient rickets there is impairment of the absorption of calcium and alterations in the calcium and phosphorus metabolism. Calcification of bone is limited at the stage of deposition of calcium in the osteoid. The osteoblasts proceed with the laying down of osteoid, but this cannot be ossified in the usual manner. In addition, the older cartilage cells are not destroyed, and vascularization of cartilaginous areas in the process of bone formation does not

occur Accordingly the rachitic costochondral junction presents a dis organized broad band of proliferative cartilage cells and irregular cal cification Such a microscopic picture is reflected grossly in the costochondral beads and the enlarged wrists and ankles

The exact chemical disturbance in calcification continues a subject of active investigation Serum calcium levels though low are as a rule not markedly depressed Serum phosphorus on the other hand is de creased Serum phosphatase activity is increased According to Jeans [88] values of less than 15 Bodansky units per 100 milliliters of serum may be taken as evidence of the nonexistence of rickets

**Clinical Picture** The infant with mild rickets may exhibit little in the way of physical findings except irritability restlessness during sleep and possibly slight beading of the ribs at the costochondral junction In severe cases pronounced enlargement of the costochondral junctions flaring of the lower ribs and a depression along the line of attachment of the diaphragm give rise to the classical rachitic chest deformities In addition the head appears large with prominent frontal bosses and some flattening of the crown This produces the appearance of the box head Upon palpation soft areas of craniotabes may be detected Closure of the sutures is delayed

The musculature is flabby the abdomen often protuberant The child may appear pale and listless Roentgenologic examination of mod erate to severe cases of rickets shows cupping of the ends of the ulna diminished calcification and a fraying of the margin of the epiphyseal end of the shaft of the long bones

The diagnosis of rickets is made on the basis of the history physical chemical and roentgenologic findings and response to therapy The disease picture may readily be confused with a variety of more rare diseases such as Fanconi s syndrome resistant rickets renal rickets and the like A discussion of these is outside the scope of the present treat ment The reader interested in these conditions is referred to the excel lent monograph of Albright and Reifenstein [86]

**Osteomalacia or Adult Rickets** Osteomalacia or adult rickets due to a lack of vitamin D and calcium in the diet is exceedingly rare in the United States Indeed Albright and Reifenstein[86] state that they are cognizant of no single case of osteomalacia due to simple vitamin D lack occurring in the United States While it is difficult to reconcile this experience with the frequent statements that there is widespread calcium deficiency manifested by impairment of calcification of the skeleton in adults it seems to us that the more critical view taken by Albright is well founded

**Prevention and Treatment** Vitamin D deficiency may be prevented either by exposure of the infant to effective quantities of sunlight or the administration of vitamin D The latter is more dependable Ad ministration of 400 to 800 I U of D activity per day suffices to protect the child Vitamin D may be given in any form—cod liver oil the more concentrated fish liver oils or in milk fortified with vitamin D Evap orated milks are fortified in amounts calculated to provide 400 I U of vitamin D per reconstituted quart All the fluid milk which is fortified

of the American Medical Association contains at least 400 I U of the vitamin per quart Accordingly, the feeding of these milks provides the child with adequate supplies of vitamin D The administration of excessive quantities of vitamin D is to be avoided because of the ill effects of hypervitaminosis D Indeed, relatively small overdoses of this vitamin may be manifest by anorexia and other undesirable symptoms in the child

The single dose treatment or prevention of rickets may be considered, particularly in areas where daily administration of the vitamin is difficult or uncertain The parenteral administration of 500,000 to 1,000,000 units of vitamin D to children is being done in some clinics, particularly in Europe, to offer seasonal protection to the infant

The therapy of active rickets consists in the administration of 4000 to 5000 units of a dependable source of vitamin D per day, coupled with the provision of a diet which meets the nutritive requirement of the child After healing of the active rickets, the usual preventive intake of the vitamin should be advised

## KWASHIORKOR

Kwashiorkor is a nutritional syndrome first described under this name by C D Williams [89] The name is of African origin and signifies "red boy" Numerous terms have been applied to this and to closely related syndromes among which one may mention Mehlnahrschaden, malignant malnutrition, infantile pellagra, and M'buaki It is widespread in economically underdeveloped tropical and semitropical regions and has been most intensively studied in Africa

In an excellent report on the disease, Brock and Autret[90] characterize Kwashiorkor among indigenous Africans as a syndrome (or syndromes) which includes (1) growth retardation, usually in children six months to five years of age, (2) dyspigmentation of the hair and skin, (3) edema usually associated with hypoalbuminemia, (4) hepatic changes, including fatty infiltration, necrosis, or fibrosis, (5) high mortality, (6) frequent association with various dermatoses Other noteworthy features are profound mental apathy, anemia (usually normocytic or macrocytic), gastrointestinal disorders manifest as anorexia, diarrhea, and steatorrhea, and atrophy of the acini of the pancreas with resulting decrease in activity of duodenal enzyme Photophobia may be observed

It is probable that this syndrome or variants of it are widespread Thus Peña Chavarria and his co workers[91] in Costa Rica observed canities and alopecia in malnourished infants in association with diarrhea, generalized edema apathy, cirrhosis and other findings while Nicholls,[92] working in Malaya has seen a similar syndrome The pigmentary changes in the hair may be especially striking as the defect occurs at the roots, and then as improvement occurs pigmentation returns Thus alternate illnesses may give rise to bands of depigmentation —the so-called "flag sign" A closely related condition has been described by Waterlow[93] under the term 'fatty liver disease' from the British West Indies

Kwashiorkor occurs in areas where cirrhosis in adults is common, an it has often been suggested that this cirrhosis may have been initiate by the Kwashiorkor in early life [90 94]

Evidence abounds for a dietary origin of Kwashiorkor Where th syndrome occurs infants are fed on cereal gruels manioc, sugar residue and other foodstuffs low in good quality protein Milk for child feedin is almost nonexistent in these areas Indeed Hughes[95] has suggeste that the syndrome represents a form of ariboflavinosis Brock and Autre point to the low methionine content of Kwashiorkor producing diet and suggest that a study should be made of the possible relation o amino acid deficiency to the syndrome

Regardless of the exact etiology of Kwashiorkor it is apparent tha foods containing good quality animal protein (milk meat, and fish) ar protective to a considerable extent, while foods rich in vegetable pro teins (beans and peanuts) also exert some protective effects Low pro tein starchy foods have been listed by Brock and Autret as Kwashiorkor producing These include manioc, bananas, plantains, maize swee potatoes yams, white rice, millet and sorghum

The *treatment* of Kwashiorkor is not based upon provision of a singl nutrient but instead, the correction of the diet with generous supple mentation with skimmed milk Coexisting infection should be treatec vigorously but some caution is advised in the administration o antimalarials

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# 15

## *Diabetes Mellitus*

Diabetes mellitus is a constitutional disease with hereditable tendencies, the salient feature of which is a lessening or complete loss to the cell of the capacity for the utilization of sugar Deprived of its ability to oxidize sugar, the cell loses its most important source of energy, and this unsatisfied need for fuel leads to the increased destruction of protein and fat, with the liberation of still more carbohydrate, and finally to the accumulation of certain poisonous fatty acids The non-utilized sugar accumulates in the blood and is excreted in the urine

As long as carbohydrate metabolism alone is at fault, diabetes pursues a relatively benign course, but as the disorder progresses and abnormal destruction of protein and fat becomes a part of the disease complete utilization of fat is manifested by an increase in blood lipids, process, then the picture changes, and the latter disturbances, particularly those of fat metabolism, finally become dominant This in the degree and persistence of which, as measured by the plasma cholesterol content, according to many clinicians, can be taken as one index of the progress of the disease These disturbances of fat metabolism lead not only to the increased production of fatty acids, but also to definite structural damage, notably to fatty changes in the tissues and possibly to early arterial disease

**Etiology.** The cause of diabetes mellitus is not known This much, however, can with a fair degree of accuracy be said Normal carbohydrate metabolism depends upon the functional integrity of three main factors (*a*) the organs of internal secretion, (*b*) the liver, and (*c*) the tissues In this disease all three factors are disordered Until recently it has been held that diabetes in man is due primarily to an insufficiency of the islands of Langerhans of the pancreas, in support of which was pointed out the frequent (though not constant) finding of pathologic changes in these islands It is significant, however, that the course of both pancreatic and phlorhizin diabetes in an animal is profoundedly attenuated by removal of the hypophysis and, further, that diabetes is common both in cases of basophilic tumor of the anterior lobe of the pituitary and in cases of tumor and hyperplasia of the adrenal cortex From these considerations one is inclined to assume that diabetes is related, directly or indirectly, to functional impairment of several organs

The latter view is based on the well grounded belief that the relationship of the organs of internal secretion is so intimate, and their interdependence so direct, that any disturbance in the function of one will upset all the others Incrimination of the hypophysis was seen in the studies of Houssay,[1] who demonstrated that extract of the anterior lobe of this gland counteracts the action of insulin and that it can produce diabetes in normal animals Later Young[2] made the startling announcement, confirmed by Campbell and Best [3] that permanent diabetes can be produced in dogs by the injection of anterior pituitary extract The explanation of this is apparent in the discovery[4] that the change is associated with atrophy of the islets of Langerhans, particularly the beta cells Other organs also are involved, notably the adrenal and the liver Soskin,[5] who adheres to the overproduction theory, states that, while other glands are undoubtedly involved, it can for the sake of simplicity be said that the hepatic mechanism which determines blood sugar levels is dependent upon the opposing balance between the hormones of the pancreas and of the anterior lobe of the hypophysis The benefit derived from the administration of insulin, therefore, is not in the mere restoration of a missing factor, it would appear instead to be due to the re establishment of normal endocrine balance The tendency therefore has been to abandon the unitary theory of diabetes mellitus and to believe that its cause will be found, not in disordered function of the pancreas alone, but rather in a disturbance of the equilibrium normally maintained between all the organs of internal secretion A different conclusion, however, was recently reached by Wilder,[5a] who points out that only when an abnormality of carbohydrate metabolism is characterized by permanence does it resemble human diabetes and that this is observed only in those forms of experimental hyperglycemia which involve destruction of the pancreatic beta cells According to his belief, diabetes mellitus can still be regarded as a clinical entity of pancreatic origin

*Predisposing factors* are of great influence in the development of diabetes mellitus, heredity comes first A familiar tendency in this disease has long been recognized, and Pincus and White[6] demonstrated this statistically and showed that the potentiality for the development of diabetes is inherited as a simple mendelian recessive characteristic White[7] illustrates this by stating that if two diabetic persons marry, all their children are predestined to have diabetes and a fixed percentage of them will manifest the disease in each decade If a diabetic person marries a person who, though not truly diabetic, is nonetheless a carrier of this inherited trait, half the children are predestined to have diabetes If a carrier marries a carrier, one fourth of the children will have diabetes but if a diabetic person marries a pure non diabetic person, none of the children will suffer from this handicap The lesson is obvious

Obesity is next in importance among the factors which predispose to diabetes Of the men in Joslin's[8] clinic whose illness began at twenty years of age or later, 78 per cent recorded a previous overweight

ιose ι hose tolerance ιs low give a low quotient The average man on mixed diet has a respiratory quotient of about 0 83 but the diabetic atient even one with the milder type of disease as a rule has a lower gure Unusually high and unusually low quotients are occasionally ncountered and are sometimes difficult to explain

**Carbohydrate Metabolism** Of the two theories which have been dvanced to explain the abnormalities of carbohydrate metabolism in ııs disease the theory of overproduction is not without good support ı animal experiments The older theory of failure to utilize glucose perhaps more generally accepted No doubt there is truth in both ccording to the latter theory the utilization of carbohydrate is lim ed because of lack of insulin and the unutilized sugar accumulates ı the blood In health the blood contains approximately from 0 08 ɔ 0 1 per cent of sugar wider variations are frequently encountered Vhen the blood sugar value exceeds 0 14 per cent during fasting ıabetes should be suspected higher percentages repeatedly observed oint almost conclusively to this disease It is not frequent in diabetes ɔ see a blood sugar value of 0 3 or even 0 4 per cent during fasting n increased amount of sugar in the blood is practically always ac ompanied by sugar in the urine The glucose threshold varies with ıfferent patients and the exact point at which hyperglycemia leads ɔ glycosuria is not always the same As a rule when the blood sugar alue is 0 17 per cent glycosuria appears

Few patients are completely diabetic the great majority of them an burn at least some carbohydrate Also the diabetic patient has not ntirely lost the ability to store carbohydrate and to release it later ɔr metabolism This faculty for storing carbohydrate which is ser ɔusly impaired in diabetes but which no doubt varies with the verity of the disease must be taken into consideration not only in ıetabolic experiments but also in clinical work Diabetic patients are ften able to store comparatively large amounts of levulose

In all reckonings of carbohydrate metabolism clinical as well as xperimental it is the ultimate carbohydrate not merely that which as been eaten as such which must be considered Fifty eight per cent f the protein metabolized and about 10 per cent of the fat yield glucose nd this glucose as far as metabolism is concerned differs in no wise rom that taken as such by mouth This fact explains the often observed xcretion by a person with severe diabetes of more carbohydrate than e has actually received

The sugar regulating mechanism of the body derives its stimulus t least in part from dextrose itself as is seen in the fact that the ngestion of increased amounts of carbohydrate will lead to improve ıent in the ability to utilize sugar It has been shown too that an xtremely low intake of carbohydrate such as accompanies an exclusive ıeat diet will lead to a diminution in the tolerance for glucose

**Protein Metabolism** The metabolism of protein demands atten ıon in diabetes for three reasons *(a)* certain amino acids of the protein ıolecule are converted during metabolism into dextrose giving at

converted into fatty acids which increase the hazard of ketosis, and (c) since the need of the diabetic for protein is no less than that of the normal person, care must be taken to see that the patient eats an adequate though never an excessive amount of protein food

**Dextrose-Nitrogen Ratio** The D N ratio, as it is called, gives the quantitative relationship of dextrose to nitrogen in the urine and therefore the proportion of dextrose excreted to protein destroyed Each gram of urinary nitrogen represents the destruction in metabolism of 6 25 gm of protein, and since 58 per cent of protein is converted into dextrose, the metabolism of this amount of protein results in 3 65 gm of dextrose (58 per cent of 6 25 gm equals 3 65 gm) Therefore, each gram of urinary nitrogen represents the production in intermediary metabolism of 3 65 gm of dextrose, if the patient is unable to burn any glucose, all of this will appear in the urine Conversely, should the patient who is fasting or who is subsisting exclusively on protein and fat show in the urine 3 65 gm of dextrose for each gram of nitrogen excreted (a D N ratio of 3 65), then it is evident that he is excreting all his carbohydrate and that he is completely diabetic This ratio is frequently seen in experimental animals, but is a rarity in persons who have diabetes

**Fat Metabolism** This is of great interest in diabetes mellitus because the incomplete utilization of fat leads to the most serious complications, among which are acidosis and coma, possibly also arteriosclerosis This accompanies the accumulation of unutilized ketone bodies It is no longer said that 'fats burn in the fire of carbohydrate,' or that ketones remain unoxidized because of failure of simultaneous oxidation of carbohydrate These products of fat metabolism (β hydroxybutyric acid, acetoacetic acid, and acetone) are under ordinary circumstances, independently of oxidation of carbohydrate, burned in the tissues for the production of energy In the increased mobilization and oxidation of fat consequent upon the poor utilization of carbohydrate seen in severe diabetes the rate at which these bodies are formed exceeds the rate at which they are utilized and ketosis results Stadie[10] puts it well when he writes 'Up to a certain level fat metabolism is complete and there is no ketonuria Beyond this level fat metabolism is incomplete and part of the fat catabolized is excreted in the form of ketone bodies'

Altered fat metabolism is believed to play an important part in the production of arteriosclerosis including intercapillary glomerulosclerosis [10a] and possibly of other complications of diabetes Rabinowitch [11] in summarizing his experience, writes It appears reasonable to conclude that excess of blood cholesterol is an important etiologic factor in the production of arteriosclerosis in the young diabetic" Duff,[12] after reviewing the evidence obtained from animal experiments stated that these experiments do not offer a valid reason for believing that an excess of cholesterol in the diet of man plays a part in the production of arteriosclerosis Similar conclusions were reached by Weiss and Minot,[13] who were unable to demonstrate any relationship between arteriosclerosis in man and the cholesterol content of the diet Man and Peters[14] likewise saw no relationship between the level of serum cholesterol and the fat in

the diet or the degree of arteriosclerosis Apparently, this is still an open question

### RECOGNITION OF DIABETES

Before instituting treatment assurance must be secured that the patient actually has diabetes mellitus for there are many forms of glycosuria that may be misleading *So-called renal glycosuria and the glycosuria of preg*nancy give the most trouble in this regard Pentosuria, although rare, is to be considered Fasting blood and urinary sugar studies with, when desirable, identification of the reducing sugar present may suffice to confirm the diagnosis The glucose tolerance test provides a convenient method of appraising the patient's ability to burn glucose

The adult patient while fasting is given 100 gm (or, more accurately, 1 75 gm per kilogram) of dextrose in lemonade blood sugar estimations are made before and at intervals through three hours after the dextrose is taken In every case there is a rise of the blood sugar content, but the promptness with which it falls to its original level is the best criterion of the person's ability to burn dextrose A one hour two dose test (the Exton Rose test) has been devised but the comparative studies of Matthews and his associates[15] led them to conclude that a single one-hour one dose test gives the more dependable information They state that if at the end of one hour the blood sugar is 180 mg, then the patient has diabetes mellitus, if the value is 154 mg or less, the diagnosis of diabetes is not warranted However, many circumstances notably the patient s emotional state, or perhaps a previously restricted diet, will influence the result of all glucose tolerance tests

### CLASSIFICATION OF PATIENTS

There is no single criterion by which one can judge the gravity of diabetes in each case for diabetic patients differ widely in their response to treatment A good classification is that offered by Kepler[16] of the Mayo Clinic, based on the age and habitus of the patient at the time of onset of the disease

Group I
1 Juvenile
2 Adolescent and early adult
3 Adult (to 45 years)
  a Asthenic

Group II
1 Adult (to 45 years)
  a Obese
2 Senescent and senile (45 years and older)
  a Asthenic
  b Obese

While there are many exceptions it will be found that as a rule patients of Kepler s first group have a severer type of disease Their blood sugar is less stable, glycosuria is more difficult to control, and insulin reactions are more frequent The so called "brittle" diabetic patients,

fortunately few in number with their wide instability of control belong largely in this group[16a] Those of the second group manifest a milder type of disease their blood sugar is more stable and the course of their illness is less stormy

The obese patient after his weight has been reduced will sometimes be found to have a milder type of disease Fetter and his associates[17] state that in their experience the majority of diabetic patients who were 40 per cent or more overweight showed a normal blood sugar value after accomplishing adequate weight reduction with a low caloric diet Newburgh and Conn[18] reported similar experiences with elderly obese patients These they place in a separate category

To determine at the outset the severity of the illness is seldom possible A patient with a low carbohydrate tolerance on a properly adjusted diet may pursue an entirely satisfactory course and show gratifying improvement while on the other hand another patient with an apparently good tolerance may pursue a stormy course with frequently alarming ketosis An unwillingness to cooperate intercurrent infections an unfortunate temperament or a weakness toward gross dietary indiscretions—any of these may convert an apparently mild case of diabetes into one of great severity Prolonged observation of the manner in which the patient reacts not only to dietary readjustment but also to the vicissitudes of life is sometimes the only means by which the severity of the illness can be satisfactorily determined

## PREVENTION OF DIABETES

For the person whose habitus or inheritance renders him likely to contract diabetes much may be accomplished by dietary precautions The same can be said of the person in whom the occasional appearance of transient glycosuria indicates perhaps incipient diabetes Since as has been shown by Paullin and others obesity is a frequent forerunner of diabetes the middle aged person should strive to keep his weight within normal bounds The prevention of obesity may mean the prevention of diabetes This can best be accomplished through the medium of sufficient exercise and an abstemious diet With such a diet all reasonable foods may be permitted but the total quantity should be strictly limited It is the quantity as a rule rather than the kind of food which counts overindulgence of every kind should be avoided It is doubtful whether ordinary overindulgence in sweets by a normal person will bring on diabetes but for the person with a tendency in this direction such overindulgence may be a determining factor He should take sweets only in strictest moderation preferably in the form of the simpler desserts and after meals—never as candy and similar sweets and never between meals The avoidance of sauces is also advisable The patient who has so called alimentary glycosuria or the glycosuria of pregnancy should be watched over a long period to make certain that diabetes is not present

The diabetic person or the person who has a diabetic inheritance should not marry a diabetic person or indeed into a diabetic family (See the discussion of predisposing factors page 279) If this precau

tion were generally observed, the incidence of the disease would be greatly decreased

### FUNDAMENTALS OF TREATMENT

The discovery of insulin has made it infinitely easier to provide suitable food for the diabetic patient and has brought comfort and longevity to large numbers of patients, but it has not obviated the necessity for care in dietary management While the diet should be planned always to meet the needs of the individual patient certain general principles should govern its selection

**Adequate Nutrition** It is no longer considered necessary to maintain a state of undernutrition Enough food must be given to maintain body weight at the ideal level (see Table 134, Appendix) and to meet the energy requirement Since the total caloric requirement of the diabetic patient does not differ materially from that of the healthy person, the figures given in chapter 2 can be utilized To this basal figure there must be added an amount of food sufficient to take care of even the effort of sitting in the ward an additional 500 Calories is regarded as sufficient If the diabetic patient is engaged in greater activity or in actual work, a material addition to the basal allowance must be permitted, the caloric intake under such circumstances should be based on the estimated energy requirements given in Chapter 3 Initial weight reduction may be required If so a diet adequate in all respects except Calories is prescribed and readjusted as weight loss is accomplished In all instances however, the dietary pattern should be built around the appropriate modified normal diet (Chapter 11) and should insure adequacy by including representatives of the basic food groups in each day s menu plan

**Carbohydrate Restriction** Upon the assumption that the insistent demands of an excessively high blood sugar content overstimulate the islet cells of the pancreas and thus produce exhaustion with eventual degeneration of these structures it was formerly the custom rigidly to restrict the intake of carbohydrate To some degree this practice still has merit, but since an increase in the carbohydrate intake, within limits will as a rule enhance rather than diminish the patient's ability to burn dextrose it is the custom today cautiously to stimulate dextrose metabolism by well considered additions to the allowance of carbohydrate This can often be done as Richardson has pointed out with advantage to the patient and without increasing his dosage of insulin by decreasing the fat content of the diet and adding its caloric equivalent in the form of dextrose It should be noted however, that according to this author, this maneuver is not feasible for obese patients In brief it can be said that if enough insulin is used to keep the blood sugar at a safe level the diabetic patient s well being is enhanced and the course of his illness is favorably influenced by a relatively liberal allowance of carbohydrate By liberal is meant 150 to 200 gm daily a few clinicians give more

**Protein Control** Because protein stimulates metabolism and thus in the diabetic would tend to violate the rule of minimal metabolism

it was until recently thought advisable to hold the intake of this food stuff to a safe minimum The value, however, of a liberal intake of protein in increasing a person s sense of well being, and in accomplish ing benefit in still other ways has influenced physicians to recommend in many diseases a more liberal allowance of protein Within limits this applies also to diabetes For adults an allowance of 0 75 or 1 5 gm per kilogram of body weight represents the proper allowance Children re quire more protein than adults, and a daily allowance of 2 or 3 gm per kilogram appears to be the proper amount

Fat is permitted as required to complete the caloric intake

**Exercise** Exercise is an important adjunct to the treatment of diabetes Under its influence an increased amount of sugar is utilized, and the blood sugar content is correspondingly reduced This statement, however, is subject to qualification since Richardson[19] showed that it is not true of patients with severe diabetes who are receiving no insulin This investigator, studying patients who had been given neither food nor insulin for sixteen hours, observed that those with a fasting value for blood sugar below 175 mg per 100 cc experienced as a result of exercise the expected lowering of the blood sugar value but that those whose fasting value for blood sugar was above 300 mg showed under similar circumstances an actual increase in the sugar content If the patients of the latter group, however, are given sufficient insulin, they too will experience a lowering of the blood sugar value and the other benefits which accrue from exercise

Two lessons can be drawn from this first, that regular exercise should be recognized as an integral part of treatment, second, that while exer cising, the patient must be under the influence of insulin, endogenous or exogenous Likewise, every patient with controlled diabetes must bear in mind that increased exercise will lessen his need for insulin and that unless the intake of carbohydrate is increased or the dosage of insulin is reduced, insulin shock may appear This applies even more when protamine zinc insulin is used instead of regular insulin

**Good Hygiene** While hygiene may appear to have no place in a book on nutrition it cannot be ignored, for without good hygiene all dietary rules may be useless It is surprising how completely a diabetic person s *metabolic equilibrium may be upset by the most trivial cir cumstance* Worry fright, a fit of anger, a sprained ankle an attack of tonsillitis—any of these may upset the whole program and undo the benefit of weeks of careful dietary regulation Emphasis should be laid on the harmful effects of nervous strain, diabetic children should not be permitted to strive for honors in school

**Education** The intelligent cooperation of the patient is essential to secure it he must be taught the nature of his disease and the objects of treatment He must be taught to compute food values to recognize the signs of impending disaster, such as acidosis or insulin shock, and to feel his own responsibility He should appreciate the fact that gross violation of the rules may mean serious trouble or even death The necessity for a reasonable degree of precision in the arrangement of the diet should be stressed Joslin[19a] emphasizes, particularly for the younger

diabetic, the necessity for long continued strict control The patient should be taught in the beginning that only in this way can a satis factory future be realized

The responsibility for the arrangement of the diet, the administration of insulin the examination of the urine and the general regulation of the patient's life should ordinarily rest on the patient himself, but in exceptional cases some other member of the family may take over this duty Diabetic children, as young even as eleven or twelve years, have proved themselves capable of accepting such responsibility Estimations of the blood sugar content are of value to the physician, but they can frequently be dispensed with in the routine management of diabetes During the first days of determination of the tolerance, four or more specimens of urine should be examined daily Later, when the tolerance has been established, less frequent examinations will suffice When, however, there is any question as to how well the patient is doing, sev eral specimens of urine passed at different times of the day should be examined

## DIET

The dietary management of diabetes seeks to provide the patient with adequate nourishment while with the aid of insulin the urine is kept sugar free There is, however, considerable difference of opinion as to whether with the use of protamine zinc insulin this last objective should be insisted upon, the course of the illness appears to run more smoothly if a small amount of sugar is occasionally permitted to appear in the urine

The regimen should not be a standardized one Though governed by certain broad general principles it should be adjusted to meet individual needs and should be subject to such readjustments as from time to time may appear advisable As far as the handicaps of his illness will permit, the diet of the diabetic should approximate in kind and quantity that of of the normal person It must be one conducive to good health and full capacity it must be well within the limits of the patient's economic and living circumstances and satisfying to his reasonable desires as a human being and as an individual'[20]

The menu should provide each day 1 to 1 5 gm of protein per kilogram (more in children) and according to individual tolerance, 150 to 200 gm of carbohydrate Fats should be added in amounts sufficient to make up the calculated caloric requirement This requirement at rest is a rule about 30 Calories per kilogram of body weight The ratio of carbo hydrate Calories to fat Calories should be something like two to one

Concentrated forms of carbohydrate such as sugar and other sweets should be avoided and starchy foods should be taken only in limited amounts When the less concentrated fruits and vegetables are well tol erated these should constitute the bulk of the diet

Often this last provision will add needed vitamins to the diet Syden stricker and his associates[21] tell of the development of pellagra in two diabetic patients when the carbohydrate content of the diet was in creased Both responded to vitamin therapy These authors assumed that

the increased metabolism incident to the giving of carbohydrate and insulin depleted the vitamin reserves and thus precipitated a state of deficiency. It would appear wise, therefore, when the diet is not well balanced to supplement it with vitamin concentrates such as yeast or crude liver extract.

The food should be distributed widely over the day, but experience has shown that the morning meal should be light and the heavier meal taken at midday. When protamine zinc insulin is used, in order to prevent a reaction at night, a light meal carrying 15 to 20 gm. of carbohydrate can advantageously be taken at bedtime.

For obese patients the diet should be so arranged as to accomplish a gradual (not too rapid) reduction in weight. In elderly patients who are grossly overweight the blood sugar will often return to approximately the normal figure as a result of well-planned dietary restriction alone.[17,18]

**Procedure.** The institution of the diabetic regimen should not be too abrupt. Sudden drastic reductions in diet, especially of carbohydrate, have sometimes precipitated alarming ketosis and even coma. The intake of fat may be rigidly curtailed, but at first the total quantity of food should not be reduced too far, if at all, below the patient's caloric needs. The carbohydrate allowance should not be lower than 100 or 120 gm. After the diet has tentatively been fixed, if it is found on the second day that the fasting value for blood sugar remains above 140 mg. and that the urine continues to show sugar, insulin should be given, preferably protamine zinc insulin, 10 units before breakfast. This should later be increased if circumstances demand. The determination of the dosage of insulin must necessarily parallel the adjustment of the diet, but since it is extremely difficult to adjust two variables at the same time it is best to proceed stepwise. Fix the diet tentatively, and, holding this stationary, then increase the dose of insulin gradually until the fasting value for blood sugar approximates the normal and the urine is sugar-free, at least in the morning and at bedtime. It is doubted *whether it is wise at this time to attempt to keep the urine continuously* sugar-free. The danger of insulin shock is too great. Wilder[22] writes: "Except when the dose of insulin is very small (6 units only of protamine-zinc insulin) we are encouraging the patient to permit his urine to contain traces of sugar at all times. . . . In my opinion it is as important, for the comfort and safety of the patient, to avoid insulin reactions as to prevent other complications, and to insist on continuously sugar-free urine, when using protamine-zinc insulin, is to invite reactions." Mosenthal[22a] likewise recognizes the harmful effects of hypoglycemic reactions, but insists that for rehabilitation of the injured islet cells in diabetes of recent onset freedom from glycosuria is imperative. He adds, however, that freedom from hypoglycemic reactions is always of paramount consideration. It is often best to rest content with a higher blood sugar value, from 150 to 170 mg., and with the occasional appearance of glycosuria during the day. The administration of insulin and its adjustment to the patient's needs will be discussed presently.

On resuming his ordinary activities after this period of adjustment and perhaps of rest, the patient should anticipate the influence of increased

exercise by reducing slightly the dose of insulin or increasing the intake of carbohydrate Otherwise shock may follow the resumption of or dinary work

**Maintenance Diet** The maintenance diet as finally adopted cannot be rigidly fixed The requirements of a diabetic patient like those of the normal person vary within wide limits and the diet must be in dividualized True, it is possible with a fair degree of accuracy to predicate the full needs of the average adult diabetic person engaged in ordinary activities at 30 Calories per kilogram of body weight, but this figure will often require adjustment and in the last analysis only the scales will tell The appropriate maintenance diet therefore is one which according to the experience of the patient will enable him with reasonable comfort to stabilize his weight at a figure which is slightly (10 per cent) below the usual standards

**Other Dietary Methods** *High Fat Diets* Before the discovery of insulin Newburgh and Marsh [23] impressed by the inadequacy of prev alent diets devised and were bold enough to put into use their high fat diet They argued with good reason that the diets then in use were inadequate to meet the patient s total caloric needs and therefore brought about a grave state of inanition Diametrically opposed to this is the opinion of many students of the disease who believe that there is an antagonism between the metabolism of fat and that of carbohydrate and that the former limits the tolerance for the latter In addition as a final argument against the use of large amounts of fat it can be said that since the discovery of insulin physicians have been able to prescribe

**Table 63 Food Values Important in the Treatment of Diabetes***

| 30 Gm 1 Oz Contain Approximately | Carbo hydrate (Gm ) | Protein (Gm ) | Fat (Gm ) | Calories |
|---|---|---|---|---|
| Vegetables 5 per cent | 1 | 0 5 | 0 | 6 |
| Vegetables 10 per cent | 2 | 0 5 | 0 | 10 |
| Potato | 6 | 1 | 0 | 28 |
| Bread | 18 | 3 | 0 | 84 |
| Uneeda Biscuits 2 | 10 | 1 | 1 | 53 |
| Oatmeal dry weight | 20 | 5 | 2 | 118 |
| Shredded Wheat 1 | 23 | 3 | 0 | 104 |
| M lk | 1 5 | 1 | 1 | 19 |
| Meat cooked lean | 0 | 8 | 5 | 77 |
| Fish fat free | 0 | 6 | 0 | 24 |
| Chicken cooked lean | 0 | 8 | 3 | 59 |
| Egg 1 | 0 | 6 | 6 | 78 |
| Cheese | 0 | 8 | 11 | 131 |
| Bacon | 0 | 5 | 15 | 155 |
| Cream 20 per cent | 1 | 1 | 6 | 62 |
| Cream 40 per cent | 1 | 1 | 12 | 116 |
| Butter | 0 | 0 | 25 | 225 |
| Oil | 0 | 0 | 30 | 270 |

* From Joslin Root White Marble and Bailey Treatment of Diabetes Mellitus Philadelphia Lea & Febiger

with impunity much larger amounts of carbohydrate than were formerly possible and that it is possible today to provide the diabetic patient with adequate nourishment without resorting to the expedient proposed by Newburgh and Marsh

*High Carbohydrate Diets* The most significant trend in the modern management of diabetes mellitus is the tendency to give increasing amounts of carbohydrate This tendency can be traced to the discovery that an increased intake of carbohydrate will under certain circum

**Table 64 Fruits* and Vegetables, Classified as to Carbohydrate Content**
(Adams and Chatfield[25])

| Group I 3 per cent Carbohydrate | Group II 6 per cent Carbohydrate | Group III 9 per cent Carbohydrate |
|---|---|---|
| Asparagus fresh and canned | Beans scarlet runner | Apple sauce canned w p |
| Bamboo shoots | Beans snap | Apricots canned w p |
| Beans green and wax canned | Beets canned | Artichokes globe or French |
| Beet greens | Blackberries canned w p | Asparagus beans pods |
| Broccoli | Blackberry juice | Beets |
| Cabbage | Celery root or celeriac | Blackberries |
| Cabbage Chinese | Chayote fruit | Brussels sprouts† |
| Cauliflower | Chives | Carrots |
| Celery | Collards | Cherries red canned w p |
| Chard | Dandelion greens | Cherries white canned w p |
| Chicory leaves | Eggplant | Cranberries |
| Cornsalad | Gooseberries canned w p | Currants |
| Cucumbers | Kohlrabi | Currant juice |
| Dock | Lambsquarters | Gooseberries |
| Endive | Leeks | Grapefruit fresh and canned w p |
| Fennel | Muskmelon including cantaloupe honeydew Spanish melon | Grapefruit juice |
| Lettuce | Okra | Lemons |
| Mungbean sprouts | Peaches canned w p | Lemon juice |
| Mustard greens | Peppers green and red | Limes |
| Okra canned | Plums canned w p | Lime juice |
| Poke shoots | Pumpkin | Limes sweet |
| Purslane | Pumpkin and squash canned | Loganberries canned w p |
| Radishes | Squash cushaw | Loganberry juice |
| Rhubarb fresh and canned w p | Squash winter | Onions |
| Romaine | Strawberries | Papayas |
| Sauerkraut fresh and canned | Strawberry juice | Pears canned w p |
| Seakale | Tomato purée canned | Peas † very young |
| Sorrel | Turnips | Peas canned |
| Spinach fresh and canned | Watermelon | Raspberries canned w p |
| Spinach New Zealand | | Raspberry juice |
| Squash summer | | Rutabagas |
| Strawberries canned w p | | Tangerines |
| Tomatoes fresh and canned | | |
| Tomato juice fresh and canned | | |
| Turnip tops fresh and canned | | |
| Vegetable marrow | | |
| Watercress | | |

Table 64 Fruits* and Vegetables Classified as to Carbohydrate Content—*(Continued)*
(Adams and Chatfield[25])

| Group IV<br>12 per cent Carbohydrate | Group V<br>15 per cent Carbohydrate | Group VI<br>18 per cent Carbohydrate |
|---|---|---|
| Apple juice | Apples | Beans † baked |
| Apricots | Blueberries fresh and canned w p | Beans † red kidney canned |
| Beans † lima canned | Blueberry juice | Cherries sweet |
| Cherries sour | Corn † sweet very young | Corn canned |
| Grapes canned w p | Figs canned w p | Crab apples |
| Guavas | Grapes American and European types | Figs |
| Mulberries | Jerusalem artichoke, tubers | Grape juice unsweetened |
| Oranges | Kumquats | Persimmons Japanese |
| Orange juice | Loganberries | Pomegranates |
| Peaches | Mangos | Potatoes |
| Peach juice | Nectarines | Succotash canned |
| Pineapple fresh and canned, w p | Parsnips | |
| Pineapple juice fresh and canned | Pears | |
| Plums (excluding prunes) | Peas † medium | |
| Prunes canned w p | Salsify (vegetable oyster) | |
| Raspberries black and red | | |

* The canned fruits included here are all water packed products designated as w p in the lists

† This vegetable admits of classification on the basis of its carbohydrate content, but cannot be calculated at the protein figure for this group For data on its carbohydrate, protein and fat content see Table 65

stances stimulate the islet cells to increased activity[24] and will thus actually improve the patient s tolerance for dextrose The comfort and safety of the patient will also be better served if he is placed on a regimen which affords him a more liberal supply of carbohydrate

Although popular, the high carbohydrate, low fat diet providing 250 gm or more of carbohydrate daily, such as was proposed by Geyelin by Sansum, and by Rabinowitch, is not generally accepted It is argued that the diets now in use approximate more closely the normal regimen and in the course of years will be found to be more satisfactory It is only fair to add however, that in pointing the way to a distinctly more liberal carbohydrate regimen the proponents of this diet have accomplished a highly valuable service

*Weighed versus Measured Diets* It has been the custom in the majority of clinics to teach the diabetic patient to weigh his food and then to know the value of household measures so thoroughly that eventually he can make use simply of the latter A few physicians insist that the patient must always weigh his food With this we cannot agree, since there are many objections The figures obtained by food analyses are not always constant, and to insist upon great accuracy in weighing the food at the table is to make a show of precision that the circumstances seldom warrant Most important, however, is the psychologic effect involved This is a disease, not of weeks or months or even of years, but of decades, and for his happiness the patient should be permitted to live

like others, with as little as possible to remind him or his associates of his handicap Not only in its arrangement and selection should his food approximate the normal, but in its serving at the table there should be as little difference as possible. The patient should know food values so well that with the type of diet used today he can sit at any table and, without calling attention to his disease, unobtrusively make such selections and substitutions as will give him approximately the proper food. To do this he must be accustomed to the use of household measures.

**Special Diabetic Food.** Special foods for the diabetic patient are seldom necessary. On the contrary, the effort today is to permit the patient as far as possible to eat the ordinary foods which come to the table, which, with the more liberal carbohydrate diets now in use and with the aid of insulin, is not difficult. For information as to the com

**Table 65. Fruits and Vegetables, Miscellaneous Group** (Adams and Chatfield[25])

| Food | Carbohydrate | Protein | Fat |
|---|---|---|---|
| | Per cent | Per cent | Per cent |
| Avocados, Fuerte | 3 | 1 5 | 26 4 |
| Avocados, Guatemalan | 4 | 2 0 | 17 2 |
| Avocados, Mexican | 5 | 2 0 | 23 2 |
| Avocados, West Indian | 7 | 1 5 | 7 7 |
| Beans, baked | 17 | 7 0 | 2 5 |
| Beans, lima, canned | 13 | 4 0 | 0 3 |
| Beans, red kidney, canned | 17 | 7 0 | 0 2 |
| Brussels sprouts | 8 | 4 5 | 0 5 |
| Corn, sweet, very young | 15 | 3 0 | 0 8 |
| Mushrooms and truffles | 0 | 0 | 0 |
| [illegible] | 10 | 5 5 | 0 3 |
| [illegible] | 14 | 6 5 | 0 4 |
| [illegible] | 6 | 13 5 | 6 3 |

**Table 66 Fruits and Vegetables High in Carbohydrate** (Adams and Chatfield[25])

| Food | Carbohydrate | Protein | Fat |
|---|---|---|---|
| | Per cent | Per cent | Per cent |
| Bananas | 22 | 1 0 | 0 2 |
| Beans, lima, green shelled | 22 | 7 5 | 0 8 |
| Corn, sweet, medium | 21 | 3 5 | 1 1 |
| Corn, sweet, old | 26 | 4 5 | 1 8 |
| Cowpeas or blackeye peas, green shelled | 21 | 9 5 | 0 6 |
| Peas, green shelled, old | 23 | 8 0 | 0 4 |
| Persimmons, native | 32 | 1 0 | 0 4 |
| Plantain or baking banana | 32 | 1 5 | 0 4 |
| Prunes, fresh | 21 | 1 0 | 0 2 |
| Sweet potatoes, fresh and canned | 27 | 2 0 | 0 7 |
| Tomato catsup | 24 | 2 0 | 1 0 |

position of such foods table 68 abbreviated from that of Goddard Sandifur and Beatty,[26] is given

**Planning the Diet** In keeping with these discussed principles the dietary prescription for a diabetic is decided upon in terms of total caloric intake as determined by his weight The first component of this caloric intake is assigned to protein 1 0 to 1 5 gm per kilogram of body weight for adults or 2 0 to 3 0 gm per kilogram for children The carbohydrate intake is fixed at the level favored by the physician not less than 100 gm total Fat is permitted as necessary for completion of the caloric intake The physiologic fuel factors of 4, 4 and 9 Calories per gram of carbohydrate protein and fat respectively are acceptable for the conversion in dietary prescription writing For example, a patient weighing 70 kilograms of moderate activity may be estimated to expend 2400 Calories per day (see section on the Normal Diet and on Caloric Requirements) Of this protein may constitute 70 kilogram times 1 5 gm = 105 gm, or 105 gm times 4 Calories per gm = 420 Calories per day It is decided to allow the patient 270 gm of carbohydrates or 270 gm times 4 Calories per gm = 1080 Calories There remains therefore 2400 Calories—(420 Calories from protein + 1080 Calories from carbo hydrate) = 900 Calories to be supplied as fat This is equivalent to 900 Calories — 9 Calories per gm of fat = 100 gm of fat

The diet prescription therefore in grams per day is protein 105 carbohydrate 270 fat 100

The distribution of this as to time of feeding is determined in relation to the plan of insulin therapy If a long acting insulin is given it may well be advantageous to provide a portion of the intake in a before bedtime snack or at other between meal feedings

**Dietary Pattern and Menu Plan** Translation of the dietary prescrip

Table 67 A Basic Diabetic Diet (Joslin*)
(Carbohydrate 150 gm protein 70 gm fat 80 gm Calories 1600)

| Food | Unit Portion | Gm in Each Portion | | | | Total Daily Portions | Total Gm | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Weight | C | P | F | | C | P | F |
| Bread | 1 slice | 30 | 18 | 3 | | 3 | 54 | 9 | |
| Oatmeal | 1 large | 30 dry | 20 | 5 | 2 | 1 | 20 | 5 | 2 |
| Orange | 1 | 150 | 15 | | | 3 | 45 | | |
| Vegetables 3 5% | 1 cup | 150 | 5 | 2½ | | 4 | 20 | 10 | |
| Milk | ¼ pt | 120 | 6 | 4 | 4 | 1 | 6 | 4 | 4 |
| Cream 20% | ¼ pt | 120 | 4 | 4 | 24 | 1 | 4 | 4 | 24 |
| Egg | 1 | 60 | | 6 | 6 | 1 | | 6 | 6 |
| Meat | 1 small | 60 | | 16 | 10 | 2 | | 32 | 20 |
| Butter | 1 square | 10 | | | 8 | 3 | | | 25 |
| Grand total Gm (approximate) | | | | | | | C150 | P70 | F80 |
| Calories per Gm | | | | | | | ×4 | ×4 | ×9 |
| Total Calories—1600 | | | | | | | 600 | 280 | 720 |

* From Joslin Root White Marble and Bailey Treatment of Diabetes Mellitus Philadelphia Lea & Febiger

**Table 68 Diabetic Foods**
(Abbreviated from the Table by Goddard Sandifur and Beatty[26])

| | Size Package | Composition per 100 Gm | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Avail Carbo | Protein | Fat | Ash | Moisture | Nonusable Carbo | Available Glucose | Calories |
| Flours | | Gm | Gm | Gm | Gm | Gm | Gm | Gm | |
| [illegible] | 5 lb | 43 33 | 44 81 | 1 8 | 0 77 | | 9 29 | 69 5 | 369 |
| | | 43 | 41 | 2 | | | | 67 0 | 354 |
| | | 33 5 | 44 4 | 1 8 | 1 1 | 9 | | 59 4 | 327 |
| | | 0 | 41 | 0 84 | | | | 23 9 | 172 |
| | | 1 32 | 16 48 | 5 | | | | 11 4 | 116 |
| bran[6] | 1 lb | 0 | 0 | 0 | | | | 0 | 0 |
| Cellu soybean flour[6] | 1⅓ lb | | | | | | | | |
| | 4 lb | 8 | 41 | 23 | | | | 34 1 | 403 |
| Soy flour[3] | 14 oz | 2 6 | 40 8 | 18 3 | 4 35 | 4 3 | | 28 1 | 338 |
| Cellu flour[6] | 2 lb, 5 lb | 0 | 0 | 0 | | | | 0 | 0 |
| Dia mel low calorie flour[4] | | 0 | 3 37 | 0 56 | 2 08 | 9 13 | 84 86 | 2 | 19 |
| Wheat flour white* | 24⅓ lb | 74 8 | 11 4 | 1 0 | 0 5 | | | 81 5 | 354 |
| Breads | | | | | | | | | |
| Energen bread[1] | 384 gm | 44 36 | 35 94 | 5 47 | | 6 | | 65 3 | 367 |
| Gluten bread[2] | 1 lb | 13 | 25 | 0 | | | | 27 6 | 153 |
| Loeb s aerated gluten bread[3] | 12 oz | 21 | 50 | 1? | | | | 51 2 | 392 |
| Dia mel golden gluten bread sticks[4] | | 28 7 | 41 1 | 4 03 | 1 6 | 6 11 | 9 23 | 52 9 | 315 |
| White bread wheat* | 1 lb | 52 7 | 9 3 | 1 2 | 1 0 | | | 58 2 | 259 |
| Crackers | | | | | | | | | |
| Gluten biscuit[2] (40%) | | 26 4 | 41 69 | 1 25 | 1 4 | 7 2 | 21 37 | 50 6 | 283 |
| Soybean biscuit[2] | 5 oz | 1 3 | 53 8 | 9 2 | | 5 5 | 20 | 33 3 | 303 |
| Cheese tid bits[3] | 1½ oz | 17 | 34 | 38 | | | | 40 6 | 544 |
| Agar bran biscuit[1] | | 088 | 0 | 0 | | | | 0 9 | 3 |
| Loeb s dietetic bran wafers[3] | 4 oz | 5 | 23 | 10 | | | | 19 3 | 202 |
| Cellu cheese wafers[6] | | 12 5 | 12 5 | 25 | | | | 2? 3 | 325 |
| Crackers soda* | 4 oz | 73 1 | 9 8 | 9 1 | 2 1 | 6 4 | | 79 7 | 414 |
| Cookies | | | | | | | | | |
| Loeb s dietetic gluten cookies[3] | 3 oz | 30 0 | 38 0 | 18 0 | | | | 53 8 | 434 |
| Loeb s casein sponge cookies[3] | 24 per pkg | 5 0 | 54 0 | 24 0 | | | | 38 7 | 452 |
| Dia mel casein lady fingers[4] | | 0 | | | | | | † | † |
| Cellu almond wafers[6] | 7⅓ oz | 25 0 | 12 5 | 50 | | | | 37 3 | 600 |
| Cellu chocolate wafers[6] | 7⅓ oz | 12 5 | 2 25 | 25 0 | | | | 16 6 | 287 |
| Dia mel snaps assort flavors[4] | 7 oz | 0 | 10 3 | 1 43 | 2 28 | 8 22 | | 6 0 | 53 |
| Ginger snaps* | 1 lb | 76 0 | 6 5 | 8 6 | | | | 80 6 | 407 |
| Cereals | | | | | | | | | |
| (Ready to eat) | | | | | | | | | |
| Gluten bran flakes[2] | 3 oz | 21 5 | 45 5 | 7 2 | | 4 0 | 18 1 | 48 6 | 333 |
| Cellu bran breakfast food[6] | 1 lb | 2 0 | 2 0 | | | | | 4 3 | 23 |
| Loeb s bran and gluten cereal[3] | | 21 | 34 | 20 | | | | 42 7 | 400 |
| Loeb s breakfast cereal[3] | | 26 | 32 | 19 | | | | 46 5 | 403 |
| *Cellu soy crisp*[6] | | 2 0 | 4 0 | 0 | | | | 4 3 | 24 |
| Whole wheat biscuit* | 12 oz | 75 | 11 | 1 4 | | | | 81 3 | 357 |
| (To be cooked or served hot) | | | | | | | | | |
| Porridge powder[5] | 1 lb | 0 | 2 7 | 1 1 | 6 1 | 10 9 | 78 9 | 1 7 | 20 |
| Rolled oats* | 3 lb | 64 5 | 15 9 | 6 0 | | | | 74 3 | 376 |

Table 68 Diabetic Foods—(*Continued*)

| | Size Package | Composition per 100 Gm | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Aval Carbo | Protein | Fat | Ash | Moisture | Nonusable Carbo | Available Glucose | Calories |
| | | Gm | Gm. | Gm | Gm | Gm | Gm | Gm | |
| Noodles and macaroni | | | | | | | | | |
| Cellu noodles[6] | 5 oz | 0 | 6 0 | 6 0 | | | | 4 1 | 78 |
| Energen macaroni[1] | | 55 5 | 31 7 | 1 76 | | | | 74 1 | 365 |
| Egg noodles* | 8 oz | 75 2 | 11 7 | 1 0 | | | | 82 1 | 357 |
| Salad dressings | | | | | | | | | |
| Cellu mayonnaise[6] | 8 oz | 0 6 | 2 0 | 83 0 | | | | 19 1 | 757 |
| Cellu French dressing[6] | ½ pt | 0 5 | 0 25 | 70 0 | | | | 7 6 | 631 |
| No fat mayonnaise[2] | 7 oz | 0 0 | | | | | | 0(?) | 0(?) |
| Meat substitutes | | | | | | | | | |
| Protose vegetable meat[2] | 1 lb | 8 3 | 18 0 | 10 4 | | | | 19 8 | 199 |
| Savita (veg beef extract)[2] | 1 lb | 5 6 | 29 0 | 0 8 | | | | 22 5 | 146 |

[1] Energen Foods Co , Inc.
[2] Battle Creek Food Co
[3] Loeb's Dietetic Food Co
[4] Dietetic Food Co
[5] Lister Brothers Inc
[6] Chicago Dietetic Supply House
[7] Vegetized Food Inc
* Not diabetic foods Ordinary products inserted for purposes of comparison
† Percentage of protein and fat not stated

tion into a menu plan and diet is accomplished by building the dietary around the food pattern of the normal diet (q v ) to insure the inclusion of representative of each basic food group The patient s meal habits, his meal procurement (Who prepares his meal? Does he eat out? Does he carry his lunch?), his economic level and employment status and hours influence the dietary advice to be given Strong likes and dislikes or food prejudices must be recognized To allow flexibility and variety of food choice the patient must be provided with lists of food equivalents from which he may choose combinations in amounts which provide him with the quantities prescribed

Many lists of food equivalents have been prepared and used successfully by the trio of an intelligent, cooperative patient and understanding dietitian and physician All lists may fail when one member of the trio fails

The time valued tables of 3, 6, 9, 12 15, and 18 per cent carbohydrate containing vegetables and the excellent basic table of Joslin s which allow the calculation and planning of dietaries in gram quantities are given here for those who wish to use them From these (Tables 63, 64 65, 66) one may calculate diets such as shown in Table 67 Detailed daily menus can be prepared

A simdlified and convenient method of planning diabetic diets has recently been prepared cooperatively by committees of the American Dietetic Association, American Diabetes Association, and the Diabetes Branch of the U S Public Health Service[30] This method is based on

the measuring of foods in household measures instead of on weighed dietaries and on a grouping of foods into a variety of food lists termed Exchanges The quantity of any food within a given list may be considered the equivalent of any other within the list hence the term 'exchange ' The patient is instructed in terms of these exchanges These lists of exchanges are presented in tables 69 to 75 Typical daily menu patterns prepared from these exchange lists follow (Table 75)

### Table 69 Milk Exchanges—List 1

One exchange of milk contains 12 gm of carbohydrate 8 gm of protein 10 gm of fat and 170 Calories

| Type of Milk | Amount to Use |
|---|---|
| Whole milk (plain or homogenized) | 1 cup |
| Skim milk | 1 cup |
| Evaporated milk | ½ cup |
| Powdered whole milk | ¼ cup |
| Powdered skim milk (non fat dried milk) | ¼ cup |
| Buttermilk (made from whole milk) | 1 cup |
| Buttermilk (made from skim milk) | 1 cup |

### Table 70 Vegetable Exchanges—List 2

The vegetables are divided into three groups according to the carbohydrate content Vegetables in list 2A are considered to contain negligible quantities of sugar those of 2B contain more and high energy content vegetables are included in the bread exchange list 4

*List 2A* Unless more than 1 cup (200 gm ) is used these may be consumed in any quantity If more than 1 cup is eaten the serving is exchanged for a vegetable in list 2B Seasoning (especially fat) is counted as a fat or meat exchange

Asparagus
Broccoli
Brussels sprouts
Cabbage
Cauliflower
Celery
Chicory
Cucumbers
Escarole
Eggplant
Greens
  Beet greens
  Chard
  Collard
  Dandelion
  Kale
  Mustard
  Spinach
  Turnip greens
Lettuce
Mushrooms
Okra
Pepper
Radishes
Sauerkraut
String beans young
Summer squash
Tomatoes
Watercress

*List 2B* One exchange contains 7 gm of carbohydrate 2 gm of protein and 35 Calories

Beets
Carrots
Onions
Peas green
Pumpkin
Rutabagas
Squash winter
Turnip

### Table 71 Fruit Exchanges—List 3

One exchange of fruit contains 10 gm of carbohydrate and 40 Calories

Fresh dried cooked canned or frozen fruit may be used as long as no sugar has been added Look at the label on the can or package to be sure it says unsweetened or no sugar added

| | Amount to Use | | Amount to Use |
|---|---|---|---|
| Apple (2" diameter) | 1 small | Grapes | 12 |
| Applesauce | ¼ cup | Grape juice | ¼ cup |
| Apricots fresh | 2 medium | Honeydew melon medium | ⅛ |
| Apricots dried | 4 halves | Mango | ½ small |
| Banana | ½ small | Orange | 1 small |
| Blackberries | 1 cup | Orange juice | ½ cup |
| Raspberries | 1 cup | Papaya | ⅓ medium |
| Strawberries | 1 cup | Peach | 1 medium |
| Blueberries | ⅔ cup | Pear | 1 small |
| Canteloupe (6" diameter) | ¼ | Pineapple | ½ cup |
| Cherries | 10 large | Pineapple juice | ⅓ cup |
| Dates | 2 | Plums | 2 medium |
| Figs fresh | 2 large | Prunes dried | 2 medium |
| Figs dried | 1 small | Raisins | 2 tablespoons |
| Grapefruit | ½ small | Tangerine | 1 large |
| Grapefruit juice | ½ cup | Watermelon | 1 cup |

### Table 72 Bread Exchanges—List 4

One bread exchange contains 15 gm of carbohydrate 2 gm of protein and 70 Calories

| | Amount to Use | | Amount to Use |
|---|---|---|---|
| Bread | 1 slice | Flour | 2½ tablespoons |
| Biscuit roll (2" diameter) | 1 | Vegetables | |
| Muffin (2" diameter) | 1 | Beans and peas dried cooked | ½ cup |
| Cornbread (1½" cube) | 1 | (lima navy split pea cowpeas etc) | |
| [illegible] | | Baked beans no pork | ¼ cup |
| | | Corn | ⅓ cup |
| | | Pop corn | 1 cup |
| | | Parsnips | ⅔ cup |
| Macaroni etc cooked | ½ cup | Potatoes white | 1 small |
| Crackers graham (2½" sq) | 2 | Potatoes white mashed | ½ cup |
| Oyster (½ cup) | 20 | Potatoes sweet or yams | ¼ cup |
| Saltines (2" sq) | 5 | Sponge cake plain (1½" cube) | 1 |
| Soda (2½" sq) | 3 | Ice cream | ½ cup |
| Round thin (1½") | 6 | (Omit 2 fat exchanges) | |

### Table 73 Meat Exchanges—List 5

One meat exchange contains 7 gm of protein 5 gm of fat and 75 Calories

Any meat may be used except bacon or fat pork or sausage cake Cheese eggs and peanut butter may be exchanged for meat for variety

| | | | |
|---|---|---|---|
| Meat and poultry (medium fat) (Beef lamb pork liver chicken etc) | 1 ounce | Fish Haddock etc | 1 ounce |
| | | [illegible] | |
| Cold cuts (4½" x ⅛) (Salami minced ham bologna liverwurst luncheon loaf) | 1 slice | | |
| Frankfurter (8 9 per lb) | 1 | Cottage | ¼ cup |
| Egg | 1 | Peanut butter (limit to one exchange) | 2 tablespoons |

**Table 74 Fat Exchanges—List 6**

One fat exchange contains 5 gm of fat and 45 Calories

If food is fried do so with fat allowed in the diet and count the fat as an exchange

| | | | |
|---|---|---|---|
| Butter or margarine | 1 teaspoon | French dressing | 1 tablespoon |
| Bacon crisp | 1 slice | Mayonnaise | 1 teaspoon |
| Cream light | 2 tablespoons | Oil or cooking fat | 1 teaspoon |
| Cream heavy | 1 tablespoon | Nuts | 6 small |
| Cream cheese | 1 tablespoon | Olives | 5 small |
| Avocado (4" diameter) | ⅛ | | |

**Table 75 Menu Pattern**

| | Amount | List | Meal Plan |
|---|---|---|---|
| Daily | | | |
| Fruit (1 citrus) | 3 servings | | |
| Milk | 2 cups | | |
| Egg | 1 | | |
| Meat fish fowl cheese | 6 servings | | |
| Vegetables Group A | As desired | | |
| Vegetables Group B | 1 serving | | |
| Bread or cereal | 8 servings | | |
| Butter or margarine | 3 servings | | |
| Breakfast | | | |
| Fruit | 1 serving | List 3 | Grapefruit |
| Egg | 1 | List 5 | 1 soft cooked egg |
| Bread | 3 exchanges | List 4 | 2 slices of toast<br>Oatmeal |
| Butter | 1 pat or exchange | List 6 | Butter or margarine |
| Milk | ½ cup or ½ exchange | List 1 | Whole milk |
| Lunch | | | |
| Meat exchange | 2 | List 5 | Hamburger steak |
| Vegetables Group A | As desired | List 2A | Buttered green beans<br>Lettuce and tomato salad |
| Vegetables Group B | 1 serving | List 2B | Buttered carrots |
| Bread | 2 exchanges | List 4 | Baked Irish potato<br>2 hot rolls |
| Butter | 1 pot or 1 fat exchange | List 6 | Butter |
| Fruit | 1 serving | List 3 | Fresh apple |
| Milk | 1 cup | List 1 | Whole milk |
| Dinner | | | |
| Meat exchange | 3 | List 5 | Roast pork loin |
| Vegetables Group A | As desired | List 2A | Buttered asparagus tips<br>Celery sticks and radishes |
| Vegetables Group B | None | List 2B | |
| Butter or margarine | 1 pat | List 6 | Butter |
| Fruit | 1 serving | List 3 | Peach halves (water packed) |
| Milk | ½ cup | List 1 | Whole milk |
| Bread exchange | 3 exchanges | List 4 | Buttered whole kernel corn<br>Whipped potatoes<br>Bread |

In order to plan a menu from these exchanges within the framework of a diet prescription, the following suggestions have proved of value in the experience at the Vanderbilt University Hospital:

1. To determine the number of servings of bread, meat, and fat list *(a)* the milk, (2 cups as a daily allowance for an adult is a good basis); *(b)* two servings of vegetables for both lunch and dinner, one from each of the lists of vegetable exchanges; *(c)* three servings of fruit for the day.

2. Ascertain the grams of carbohydrate supplied from sources other than bread (e.g., that contained in the milk, vegetables, and fruit as set forth in the first suggestion). Subtract this carbohydrate from the total permitted by the prescription and divide the result by 15, the number of grams of carbohydrate contained in one serving of bread exchange (list 4).

3. In a similar manner determine the grams of protein allowed by the prescription but not supplied by the foods already included. The remaining grams of protein divided by 7, the grams of protein supplied by one meat exchange (list 5), indicates the number of servings of meat exchanges which may be included.

4. Ascertain in like manner the unassigned fat and divide this remainder by 5, the grams of fat provided by one fat exchange (list 6).

5. The diet is thus figured as close as possible to the prescription, but it is not feasible to split exchanges such as bread or meat. A variation from prescription of 7 gm. of carbohydrate and 3 gm. of protein is permissible.

6. A protein food should be included at each meal; the carbohydrate content should usually be divided chiefly between the three regular meals; fat usually requires no special consideration in apportioning.

7. Any between-meal feedings should include some protein and fat as well as carbohydrate. Milk is a good basis for such snacks; fruit juices alone are not usually suitable for snacks.

8. Variety in menu planning is encouraged. Consideration should be given to the food habits of the family.

## INSULIN

Insulin is the hormone derived from the beta cells of the islands of Langerhans of the pancreas. It is essential to normal carbohydrate metabolism. "It facilitates simultaneously the absorption of glucose to a specific enzymatic system responsible for the conversion of glucose into an active, labile form which is subsequently phosphorylated . . . and for the oxydation of various carbohydrate derivatives."[27] Given to the normal animal, it lowers the blood sugar content; given to the depancreatized dog or the diabetic person, it makes possible the metabolism of carbohydrate, lowers the blood sugar content, and facilitates the storage of dextrose. It is a typical protein, the component amino acids of which are in large part known, and it has been prepared in crystalline form.

*Regular insulin,* as it is now called, is limited in its usefulness by the fact that it expends its full influence within a few hours. If a constant

effect is desired, it must be given at frequent intervals, three or even four times daily. Even then its effect is not fully sustained.

*Crystalline insulin* has been recommended as superior to amorphous (regular) insulin because of its relative slowness of absorption, but the claims made for it have not been substantiated. Ricketts and Wilder[28] and several other investigators reported that the slightly longer action of crystalline insulin was not statistically significant and that it had no advantages which could be regarded as clinically important.

*Protamine zinc insulin* is a much more slowly acting agent made by the addition of zinc to protamine insulin, a product originally developed by Hagedorn[29] of Copenhagen through the chemical union of regular insulin with the protamines contained in the sperm of fish. Because of its slow absorption it produces a gradual and prolonged fall in blood sugar lasting twenty-four hours or longer. Joslin writes that he and his colleagues use protamine zinc insulin in practically all patients requiring insulin, supplementing it if necessary with crystalline insulin.

*Globin insulin*, in the duration of its effect, stands intermediate between the two types of insulin just discussed, its action lasts perhaps eighteen hours. Joslin states that although this product will control the blood sugar of mild and some moderately severe cases its action is not satisfactory for severe diabetics.

**Administration of Insulin.** *Protamine zinc insulin*, or modified protamine insulin (N.P.H. 50), is the agent of choice in new cases. After the patient's diet has been fixed at approximately the maintenance level, treatment is usually begun with the administration before breakfast of 10 units of protamine zinc insulin. The urine should be examined four times daily—morning (fasting), afternoon, evening and night—and the subsequent doses adjusted accordingly. Except in the cases of mildest diabetes it is necessary as a rule to increase the dosage of protamine zinc insulin by 5 or 10 units daily, or preferably every second day, until the urine is free from sugar or nearly so for the entire twenty-four hours. It is as a rule best, notably with severe involvement, in order to avoid an insulin reaction, to permit the patient frequently to show a little sugar in the urine, but the endeavor should be always to keep free from sugar that passed in the morning and at night. It is often necessary at some time during this "stepping up" procedure to supplement the protamine zinc insulin with 10 to 20 units of the more quickly acting regular insulin. The latter will facilitate the utilization of carbohydrate at a time when an amount of the slowly acting insulin sufficient to meet the patient's needs has not yet been absorbed. The advantage of giving both types of insulin simultaneously, or modified protamine insulin, is becoming increasingly apparent. In uncomplicated diabetes 40 units or less of protamine zinc insulin will as a rule suffice, but occasionally it becomes necessary to give 60 units or more. Such changes in dosage should not be made too rapidly or too abruptly, for the effects of protamine zinc insulin are often cumulative. As the maintenance dose is approached, further changes should be made only every two or three days.

Readjustments of the meals will sometimes make possible the administration of a smaller amount of insulin than otherwise would be needed By providing less food just prior to the time when sugar is ordinarily found in the urine and a larger amount at a time when it is known that it is regularly free from sugar a better balance is maintained Here again changes should not be made too rapidly after each change of this sort two days or more must elapse before results can properly be read

*Regular insulin* is still taken by many patients who have found its use thoroughly satisfactory and also by those who after an attempted change have concluded that the old is preferable to the new Beginning with a small dose (5 to 10 units) before breakfast these patients have as a rule adjusted their insulin in a stepwise manner until a maintenance daily dosage of 10 to 60 units is taken seldom more This amount is taken preferably before meals in one two or three doses the amount of each depending as determined by examinations of the urine upon the insulin need for that particular period If the amount needed is small (10 to 20 units) it may be possible for the patient to get along with one dose If more is needed two doses (morning and evening) or perhaps three doses should be given In a few cases of severe diabetes it is desirable to give even a fourth dose of 3 to 5 units at bedtime Unless the patient is doing remarkably well on the old however and unless trying difficulties are encountered with the new it is advisable as a rule to change from regular to protamine zinc insulin

*To make the change* from regular insulin to protamine zinc insulin involves difficulties but these can usually be overcome if the duration of action of the latter and its slowness are understood if patience is exercised and if conclusions are not too hastily drawn Three days to two weeks are usually required for this change during which period it is of distinct advantage to have the patient in a hospital

*Mixtures* of regular insulin and protamine zinc insulin have an advantage over either product given alone Colwell[31] recommends a stock mixture consisting of two parts of solution of insulin crystals with one part of protamine zinc insulin both in the U 80 strength and states that this mixture is stable in the ampule A stock mixture however does not permit the flexibility and adaptability to the requirements of the individual permitted by ready made mixtures As a result of their studies Collens and his associates[32] write that there is apparently no relationship which would help in predicting the requirement of insulin based upon previous separately injected doses Their patients required mixtures in different ratios ranging from 1 1 to 5 1 of the unmodified to protamine insulin but in the great majority of their patients taking mixtures irrespective of the severity of the disease diabetes was best controlled with a proportion of two parts of soluble insulin to one part of protamine insulin Similar conclusions have been reached by other investigators

*Modified protamine insulin* (NPH 50) made by the addition of 0 50 mg of crystalline protamine for every 100 units of insulin is relatively quick in action and has an influence of long duration (about twenty

*eight hours)* *It resembles the 2 1* mixture of regular and protamine zinc insulin that is in favor today Izzo and Crump[32a] report that this type of insulin has an advantage of producing a more level type of response with fewer conspicuously high or low points Priscilla White[32b] writes that in 95 per cent of a large group of patients with severe diabetes this form of insulin was used as successfully, if not more so than separate injections of regular and protamine zinc insulin She regards it as a desirable insulin for the treatment of severe labile diabetes

The *dextrose equivalent of insulin* cannot be expressed by a fixed figure The larger the dose of insulin, the smaller, as a rule its unit equivalent in carbohydrate As a rule 1 unit of insulin will metabolize 1 5 *to* 2 gm of dextrose, *and sometimes much more Exercise increases* this figure as does the administration of additional carbohydrate When liberal amounts of carbohydrate are being taken, the amount of this foodstuff can be materially increased, even doubled, with little increase in the dosage of insulin, provided the total caloric intake is appropriate This fact is the basis of the diets higher in carbohydrate An opposing effect is produced by infections and other complications of diabetes, notably coma Under these conditions much less carbohydrate per unit is utilized Many circumstances govern the amount of dextrose which can be metabolized with the aid of 1 unit of insulin

*Technic* Regular insulin is placed on the market for clinical use in vials of varying strength, labeled U 20, U 40, U 80 and U 100 Protamine zinc insulin and modified protamine insulin (N P H) can be obtained in strengths of U 40 and U 80 The figure which follows the letter U indicates the number of units in 1 cc of that preparation, thus U 20 *carries 20 units to 1 cc, and U-40 carries 40 units* Care *must be taken* not to confuse units with cubic centimeters

The technic of administration is simple, but accuracy and cleanliness are demanded Insulin is given subcutaneously, since that given intravenously is probably excreted quickly in the urine Rarely however, when the patient is comatose it may be given intravenously The patient or a member of the family, preferably the former, should be taught to give the injections and to vary the dose as the state of the urine and other circumstances may demand The dose should be expressed always in units, never in cubic centimeters For this purpose special syringes, graduated in units, have been placed on the market It is a simple matter for the patient, knowing the strength of his preparation of insulin, to measure his doses Needles of 25 to 29 gage, from ¾ to 1 inch (1 9 to 2 5 cm) in length, are preferred The syringe and needle should be boiled in the usual manner before use The injection *should be made into the loose subcutaneous arealar tissue* It should not be made into the skin, for this will produce pain and possibly a scar to avoid this the precaution should be taken to see that the point of the needle is freely movable under the skin before the injection is made Joslin advises that a new site for injection be selected each day and that the same site not be used more often than once a month The physician should assure himself before delegating treatment to the patient that the latter thoroughly understands *(a)* how to boil and aseptically handle

the syringe and the needle and the necessity therefor, *(b)* the accurate measurement of a dose, *(c)* the technic of subcutaneous injection, and *(d)* the nature and treatment of insulin shock

**Insulin Reactions** An overdose of insulin when the reserves of glycogen are exhausted, produces hypoglycemia and a group of characteristic symptoms If uncorrected, this condition may lead to disaster When the blood sugar level is reduced to 0 07 or 0 05 per cent, there may be a feeling of nervousness, uneasiness, tremulousness, weakness and excessive hunger The pulse is rapid, and often there is a characteristic facial expression, with dilation of the pupils The patient learns to recognize promptly the nature of these symptoms and to terminate them by taking carbohydrate, or they may cease spontaneously Usually, however, the condition if uncorrected proceeds to the production of more alarming symptoms—sweating, flushing, pallor, emotional upset, fainting, diplopia and incoordination With a further fall of the blood sugar level, there may be aphasia, confusion delirium, convulsions coma and eventually death

Sometimes the symptoms are less obvious Joslin has observed that when a diabetic child becomes quiet and listless or an adult patient appears depressed, worried and without ambition, he is perhaps suffering from a mild insulin reaction and is in need of food The opposite symptoms, extreme irritability and emotionalism may have the same significance

Although the severity of the symptoms usually accords with the extent of the hypoglycemia this is not invariably true Maddock and Trimble[33] state that values of 50 mg per 100 cc or lower sometimes persist for several hours without symptoms, and Rabinowitch and Peters[34] wrote of a patient without symptoms in whose blood no true sugar could be found I had a patient who when first transferred to protamine zinc insulin was entirely comfortable at all times even though his blood sugar level occasionally fell to 38 or 37 mg but convulsions suddenly occurred one day when he took too much exercise

The reactions caused by protamine zinc insulin differ, sometimes markedly, from those caused by regular insulin They are distinctly more treacherous and often are more malignant Headaches are much more frequent Otherwise the symptoms are largely the same but as a rule they come on more slowly They may not be recognized at first and apparently without warning the patient may lapse into coma Hypoglycemia from protamine zinc insulin may come on ten to twenty four hours after its administration, and unless epinephrine is given and dextrose is administered intravenously the symptoms may be alarmingly prolonged The salient features of the reactions from this source are that they are more difficult to combat and that they tend to recur when it is thought that the patient has safely recovered The important fact to be remembered in this type of reaction is that the dextrose or other carbohydrate given the patient should be repeated hourly until it is known that the insulin has exhausted itself

The differentiation of insulin shock and diabetic coma is not always easy A low blood sugar value should suggest the former, while a high

blood sugar value with a low carbon dioxide combining power of the plasma should suggest the latter When this information is not available, the catheterized urine should be examined, the persistent presence of sugar and diacetic acid may be taken as a sign of diabetic coma At the bedside, labored respiration, anhydremia and softness of the eyeballs suggest diabetic coma, but if the skin and mucous membranes are moist, the eyeballs hard, the pupils dilated the face pale, the breathing easy and soft and the temperature distinctly subnormal, then insulin shock seems the more likely possibility

The treatment of hypoglycemia and the accompanying reaction is simple The danger is that insulin shock will develop unrecognized or that it will be mistaken for diabetic coma and, in a case in which protamine zinc insulin has been used, that the treatment will be discontinued too soon Dextrose, preferably as orange juice, will cause a prompt rise in the blood sugar content and relief of symptoms Corn syrup or any sugar will suffice If the patient will take the juice of two oranges, a few pieces of candy or a few lumps of sugar, the symptoms will promptly disappear, but if protamine zinc insulin has been used, he may a little later lapse into unconsciousness or have convulsions To prevent this the treatment should be repeated hourly for several hours Subsequently the dose of insulin should be reduced or the diet increased

Severe shock demands similar remedies, with even more prompt administration If the patient is unconscious dextrose solution should be given intravenously About 200 cc of a 5 per cent solution of dextrose is the proper intravenous dose, but stronger solutions may be given in smaller amounts Epinephrine is a rapidly acting antidote for hypoglycemic shock provided the patient has glycogen in reserve It will not serve as a substitute for carbohydrate and therefore should be immediately followed by the giving of dextrose One cubic centimeter of a 1 1000 solution of epinephrine should in urgent conditions be given subcutaneously while preparations are being made for the administration of dextrose

*Insulin resistance* in which condition relatively enormous doses of insulin (500 units or more) are apparently required, has been reported It is believed that this represents a local or a general allergic response to insulin but its exact nature is not clearly understood [34a]

## DIABETES IN THE CHILD

The treatment of diabetes in the child is governed by the same general principles that apply in the treatment of the adult Closer scrutiny, however, is demanded for several reasons (1) juvenile diabetes is as a rule of a severer type (2) the demands of growth in childhood call for more protein (1 5 to 3 gm) (3) the margin between hyperglycemia and hypoglycemia in the child is narrow, and insulin shock is therefore more easily produced, and (4) emotional factors in the diabetic child are more likely to influence the course of the illness

The dietary standards given in Chapter 11 for the normal child may be taken as a criterion of nutritive requirement However, these stand

ards apply to active, healthy children who take an enormous amount of exercise, and since the activities of the diabetic patient are somewhat restricted, they should be modified accordingly. As with the adult, moderate undernutrition is desirable.

Priscilla White[7] advises that the dietary regulation of uncomplicated juvenile diabetes be undertaken in two phases, initial adjustment and periodic readjustment to allow for growth and development. In the process of desugarization she advises undernutrition, with a diet containing 100 gm. of carbohydrate, 1 gm. of protein and enough fat to yield 30 Calories per kilogram of body weight. The diet is increased daily until a food allowance appropriate for the age and size of the child is reached. In her experience the following diets have been satisfactory in that they have produced an average gain of ½ to ¾ pound (227 to 310 gm.) per month and have permitted the maintenance of blood sugar levels below 200 mg., less than 10 gm. of sugar in the urine in twenty-four hours and a normal blood cholesterol value.

Table 76. Average Diet in Grams for Diabetic Children (White[7])

| Age Yrs | Cals/kg | P/kg | C | P | F | Cals |
|---|---|---|---|---|---|---|
| 5 | 75 | 3.0 | 140 | 60 | 70 | 1400 |
| 10 | 65 | 2.5 | 160 | 70 | 80 | 1600 |
| 15 | 45 | 1.5 | 180 | 85 | 90 | 1900 |

According to the child's needs, a caloric increase of 5 to 10 per cent every six months or year is permitted in order that he may increase *each year 2 inches (5 cm.) in height and 6 pounds (2.7 kilograms) in* weight. During adolescence the increase should be twice as much. The arrangement of the meals and the dosage of insulin must vary, not only according to the differing needs of different children, but also according to the changing routine of the individual child.

Coma and hypoglycemia must be watched for more closely in the child than in the adult. Intercurrent infections, among other causes, may precipitate the former, and failure of the food to be absorbed after the administration of insulin may lead to the latter. Both complications are treated essentially in the same way as in the adult. White lists pseudodwarfism as a newly recognized complication of juvenile diabetes and believes that it is due in part to overactivity of the anterior lobe of the pituitary. The administration of an appropriate endocrine extract (plus good diabetic treatment) has been tried with some success in such cases[35] but the opinion has also been expressed by Boyd and his associates[36] and by others that proper control of the diabetes alone will be as effective in preventing this complication as the degenerative lesions of diabetes. Nonconformity to dietary regulations with its penalties and inadequate insulin are the usual sources of trouble. To forestall pseudodwarfism, the child's growth should be checked regularly. White also emphasizes the relative frequency of arteriosclerosis and cataract as complications of juvenile diabetes and points to the statistical relationship which both bear to hypercholesteremia.

An *unrestricted diet* in the treatment of juvenile diabetes is favorably regarded by Guest.[37] This is a more or less self-selected, unmeasured

diet, but it does not permit complete freedom of choice, certain simple rules must be followed Under this regimen insulin dosage is adjusted to permit constant mild glycosuria with precautions against the development of acetonuria Guest s experience at the Children's Hospital Research Foundation, Cincinnati, indicates that children on this regimen show normal growth and development with minimal ill health and that hospitalization is rare A different conclusion was reached, however, by Priscilla White,[37a] who advises accurate chemical control of diabetes, which can be accomplished only with the controlled regimen Instead of prescribing a free diet for the diabetic child, she advocates a controlled diet for the entire family A like opinion was expressed by Wilson and his associates,[37b] who reports that their observations "definitely support the concept that continuous, aggressive treatment, directed toward maintenance of physiologic conditions is a better form of management of diabetes than the free diet plan which permits a constantly disturbed metabolic state, reflected in persistent hyperglycemia and glycosuria "

## SURGERY IN DIABETES

The properly treated diabetic patient may be operated upon today with no more risk than ordinarily attaches to like operations under other circumstances Such a patient, however, requires the closest attention Well planned preoperative preparation is important

Promptness in operating on a diabetic patient is just as necessary as for any other patient, but the operation should be delayed a sufficient length of time, if possible, to get the hyperglycemia under control and to insure storage of glycogen in the liver To combat an infectious process surgically, however, is sometimes the quickest way to get diabetes under control If time permits, three things should be accomplished

1 The patient should be supplied with an abundance of fluids The administration of water and other liquids by mouth or, if necessary, by *protoclysis is advisable, large amounts should be given the day before* operation

2 Since an adequate store of glycogen is good insurance for the recovery of any patient, the effort should be to induce the diabetic patient who is being prepared for operation to store as much glycogen as possible This is accomplished by permitting a liberal intake of carbohydrate Sudden restriction of carbohydrate should be avoided Orange juice, oatmeal gruel, Cream of Wheat and milk are carbohydrate foods which may be depended on Vegetable purees are also valuable The patient should be fed up to twelve hours before the operation and as soon afterwards as possible

3 Sufficient insulin should be given to enable the patient to oxidize the carbohydrate administered, and thus to guard against acidosis Root advises that the same amount of insulin per twenty four hours be given, but that it be divided into small, frequent doses, irrespective of meals Even when insulin has not previously been used, it should be given when two successive specimens contain sugar, but may be omitted when two successive specimens are sugar free

Regular insulin or protamine insulin may be used, in accordance with

the patient's earlier treatment The policy at the Mayo Clinic, according to Kepler,[16] is to give from one half to two thirds of the usual dose of protamine zinc insulin on the morning of the operation By the time it begins to have an effect, the need for it will have arisen If the patient has been taking regular insulin as well, the regular insulin is given at this time in greatly reduced amount or is omitted altogether If glycosuria appears after the operation, however, it is corrected by means of regular insulin Thereafter the same daily dose of protamine insulin is given, to which is added such regular insulin as may be necessary, this is continued until, on recovery, the patient is restored to his usual regimen

In the choice of the anesthetic, chloroform and ether should be avoided Amytal also is regarded as a dangerous agent in diabetes If morphine is necessary, the dose should be as small as possible Spinal anesthesia in certain cases, as in amputations, is eminently suitable The intravenous use of pentothal is well recommended

## DIABETIC COMA

Diabetic coma is a preventable accident It occurs because the patient has taken too much food or too little insulin or because he is laboring under the added handicap of an infection The failure of carbohydrate to burn results in the increased utilization of fat, and this, through the production of ketones in amounts greater than can be oxidized in the tissues, leads to the accumulation of these bodies in the blood, with loss of fixed base, and eventually to acidosis This last is probably not responsible for diabetic coma but signals a metabolic disturbance so severe as to portend coma and death'[5] This vicious train of events can be reversed by the aid of insulin and the resulting increased oxidation of dextrose Formerly diabetic coma was almost invariably fatal, but today it is possible to relieve these patients, provided the coma is not of too long standing If it is permitted to persist long, however, this disordered chemical status, through acidosis or otherwise, eventually produces irreparable damage to the central nervous system, myocardium and other structures Few medical emergencies demand such prompt action as diabetic coma

The recognition of coma or impending coma is not always easy It may come on suddenly or insidiously A prolonged fall in the carbon dioxide combining power of the plasma and a marked reaction of the urine to ferric chloride are highly significant signs A plasma carbon dioxide combining power of 20 volumes per cent or less is assumed by Joslin to be indicative of coma One must learn, however, to depend also upon the patient's general appearance It is best to be always on the alert and as emphasized by Joslin to treat any unusual symptoms as premonitory of coma this is especially true in the presence of fever or other evidences of infection This author lists the following premonitory symptoms headache, anorexia restlessness, listlessness, nausea, vomiting, drowsiness, painful, rapid or deep breathing, and extreme weakness As the coma deepens, there is added the typical Kussmaul respiration, with eventual circulatory failure Sometimes there are pronounced gastro-

intestinal symptoms, perhaps with abdominal pain simulating that of appendicitis The mouth and tongue are dry, and the eyeballs are soft Campbell emphasizes the fact that evidences of dehydration are always present and says that a patient with a tongue moist at the edges is relatively safe for several hours at least

The differential diagnosis is not always easy Cerebral hemorrhage and insulin shock have not infrequently been treated as diabetic coma Joslin quotes the advice of Rosenberg that to differentiate coma and insulin shock one may cautiously give intravenously a small amount of concentrated dextrose solution if recovery is definite and prompt, the presence of the latter condition may be assumed

**Treatment** In the treatment of coma and the precomatose state it is well to bear in mind that the ordinarily observed carbohydrate equivalent of insulin does not hold good, these patients take large doses of insulin without experiencing hypoglycemia As one writer puts it they soak it up like a sponge There is no exact dosage of insulin at this time At the first sign of impending coma 30, 40, 50 or perhaps 100 units of insulin should immediately be given An hour later, if the urine obtained by catheter still contains sugar, another 30 or 40 units should be given thereafter the administration of insulin should be continued at the rate of 10 or 20 units every hour as long as the urine contains sugar or until the patient is beyond danger

When the patient is already comatose, even more energetic measures are demanded The insulin at this stage can in part, if necessary, be given intravenously 40 or 50 units as the first dose, then an hour later 30 units or more, and thereafter 10 to 20 units hourly, as previously advised Larger doses are frequently given Baker[38] reported from the Mayo Clinic that the average amount of insulin administered in the first twenty four hours to a totally unconscious patient was in earlier years 170 units for a similar condition since 1930 the average amount has been 253 units *There is no rule regarding the administration of insulin which will apply in every case of diabetic coma* Much depends upon the previous course of the disease, the age and weight of the patient the carbon dioxide combining power of the plasma and the duration and depth of the coma

It was at first thought that protamine zinc insulin was not suitable in diabetic coma but it is now widely used, the precaution being taken always to buffer it with sufficient carbohydrate Kepler states that at the Mayo Clinic the comatose patient is given one large dose of protamine zinc insulin, after which treatment proceeds as if no insulin had been given For its immediate effect, regular insulin is also given

It is important that the patient have sufficient sugar to metabolize The juice of two or three oranges will furnish this if he is nauseated dextrose may be given intravenously When coma is present or imminent everything depends on promptness and rapidity of action immediately after the first dose of insulin, dextrose should be given intravenously—from 500 to 1000 cc of a 5 per cent solution according to the amount of insulin administered It has been argued that with a surplus of sugar circulating in the blood the giving of dextrose is

unnecessary, but unchecked acidosis is so perilous that the physician is warranted in administering such amounts of dextrose as will permit heroic doses of insulin The underlying diabetes can be dealt with later

To prevent the harmful effects of dehydration, large quantities of water should be given, at least a glass of water every half hour If the patient is nauseated or comatose, constant proctoclysis or the frequent administration of salt solution subcutaneously or intravenously is imperative

The propriety of giving alkalis in diabetic coma is still under discussion Baker[38] found alkalis useful and suggests the following signs as indications for their administration (1) the presence of distressing hyperpnea, (2) the presence of a deeply depressed alkali reserve, especially when the value for the carbon dioxide combining power of the plasma is less than 10 volumes per cent, and (3) failure of insulin to elevate the carbon dioxide combining power of the plasma or to relieve the stupor The use of sodium lactate in a sixth molar solution is recommended by Beardwood and Rouse,[39] who state that it presents the advantages of quicker recovery (chemical and clinical), less danger of alkalosis and less tendency for complications Opposed to this is the view of Joslin, in whose experience alkalis are needless A like opinion is held by Story and Root[39a] who are opposed to the use of alkali because there is potential danger of overuse and because their experience has shown them that it is unnecessary for clinical and chemical recovery

The treatment of diabetic coma was well summarized by Joslin and his associates[40] when, in reporting a remarkably low mortality, they wrote

> Our results have been secured by the use of (1) insulin given subcutaneously and at times intravenously every fifteen to thirty minutes in doses of 20 to 50 units (occasionally as high as 100 units especially intravenously) amounting in the average case to approximately 200 units in twenty four hours (2) the liberal use of salt solution subcutaneously and often intravenously as well to combat dehydration (3) lavage of the stomach in nearly all instances unless the attending doctor accepts full responsibility for its omission (4) liquids by mouth at an initial rate not to exceed 100 cc *hourly and (5) unless 50 Gm of soluble carbohydrate or more is taken in the first* twelve hours and again in the second twelve hours dextrose intravenously or subcutaneously and (6) always an endeavor to protect and stimulate the circulation by good nursing and by the use of epinephrine and ephedrine for falling blood pressure

## OTHER COMPLICATIONS

Neuropathy This complication, according to Rundles,[41] comes only after months or years of uncontrolled diabetes It is due neither to primary vascular disease nor to a primary or conditioned vitamin B deficiency The clinical studies of this author lead him inescapably to the conclusion that diabetic neuropathy is not only truly diabetic in origin, but results from the abnormal metabolism of the chronically unregulated disease The lesson is obvious

Intercapillary Glomerulosclerosis This is a characteristic syndrome consisting in hypertension edema, proteinuria and retinitis, which sometimes occurs in young people with diabetes of long duration The prog

nosis is grave, but it is hoped that the disorder can be relieved somewhat by better control of the diabetes [10a]

Gangrene The prevention of this complication is largely the care of the feet Although arteriosclerosis is a basic cause, trivial infections often precipitate the disease Joslin and his associates tell in detail of the hygiene of the feet often necessary for the prevention of this disorder. Amputation in diabetic gangrene and the types of operation indicated were discussed fully in a report by the Council on Physical Therapy of the American Medical Association [42] Radical amputation was advised (1) for all patients with septicemia secondary to gangrene, (2) for extending infection in spite of skilled treatment, (3) in the presence of extensive infection, and (4) for markedly debilitated patients with severe sepsis

## SPONTANEOUS HYPOGLYCEMIA

An increased output of insulin, resulting in hypoglycemia with attendant symptoms, occurs in cases of adenoma and other tumors of the pancreas and also at times when the structural integrity of this organ is apparently unimpaired The first case of hypoglycemia due to a tumor was reported in 1927 by Wilder and his associates,[43] who described the convulsions and other symptoms as well as operative and necropsy observations Three years earlier Harris[44] described spontaneous hypoglycemia, to which he gave the name of hyperinsulinism Low blood sugar content is a symptom of a variety of disorders, notable among which are derangements of the several organs of internal secretion and of the autonomic nervous system It is true that the excessive production *of insulin is one of the most common causes of periodic spontaneous* hypoglycemia in man, but it is by no means the only cause Many other abnormalities, notably hepatic disease, pituitary hypofunction, adrenal hypofunction and lesions of the central nervous system, will produce the same train of symptoms Emotional factors are sometimes responsible The propriety, therefore, of regarding spontaneous hypoglycemia as a disease entity is open to question

This syndrome is classified by Conn[45] under two main headings (1) the stimulative hypoglycemias and (2) the fasting hypoglycemias The first of these, the stimulative hypoglycemias, are believed to be the result of an abnormally sensitive secretory mechanism which, following an ordinary stimulus, permits an excessive response from histologically normal pancreatic cells (functional hyperinsulinism), or, to represent the excessive stimulation of a normal mechanism, is the stimulation which comes from the too rapid absorption of carbohydrate In either case, after the postprandial stimulus, there ensues a sharp fall in blood sugar The former of these states, functional hyperinsulinism, accounts for about 70 per cent of all cases with clinical manifestations It has the following characteristics (*a*) a normal fasting blood sugar with no hypoglycemic episodes before breakfast, (*b*) attacks that occur postprandially, most often in the forenoon and late afternoon, (*c*) failure of the attacks to occur as the result of fasting or the omission of a meal and (*d*) a typical oral glucose tolerance curve It was for this type of

hypoglycemia that Waters[46] introduced the low carbohydrate diet subsequently revised by Conn to include large amounts of protein

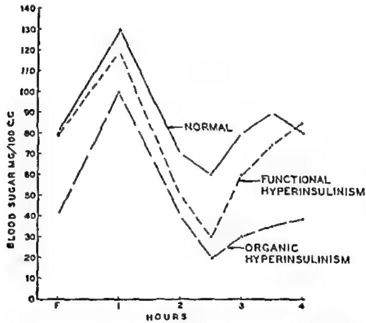


Fig 12 Dextrose tolerance test (standard dietary preparation) (Conn J W The Dietary Management of Spontaneous Hypoglycemia Am J Dietet A Vol 23)

The second group in Conn s classification the fasting hypoglycemias are characterized by an abnormally low fasting blood sugar level and by an intensification of the hypoglycemia when the person refrains from eating or when carbohydrate is omitted from the diet In this group are included the following hepatogenic hypoglycemia, hypopituitarism, adrenal cortical hypoglycemia and prolonged inanition It is obvious that the low carbohydrate diet devised for stimulative hypoglycemia is contraindicated in this condition These patients fare best upon a high carbohydrate high protein diet with provision for a bedtime meal

*Organic hyperinsulinism (pancreatic insuloma) presents characteristics* of both types of hypoglycemia Because of the excessive output of insulin, carbohydrate is quickly utilized and hypoglycemia occurs soon after a meal, and it is for the same reason also that fasting hypoglycemia occurs Dietary regulation is of no value in this condition, when the diagnosis has been made the patient should have the benefit of surgery

The manifestations of hypoglycemia vary greatly In the milder forms they consist in weakness, easy exhaustion, visual disturbances tremulousness and such vasomotor disorders as sweating, flushing and tachycardia Among the psychic manifestations are irritability changes in personality, disorientation and drowsiness In the severer grades convulsions and coma occur

The diagnostic test of greatest value is the dextrose tolerance test but Conn[47] insists that this test should be preceded for several days by the ingestion of an adequate diet he proposes a standard preparatory diet which carries 80 gm of protein and 300 gm of carbohydrate and pro-

vides 2800 Calories Two to five hours after administration of the standard dose of dextrose (1 75 gm per kilogram) the blood sugar level of patients with this disease often falls precipitately To catch such a drop this author takes samples of blood every thirty minutes after the second hour for two or three hours At some time during this period the blood sugar will reach a low level 28 to 40 mg per 100 cc This low type of curve is encountered in both organic and functional spontaneous hypoglycemia provided there has been no previous undernutrition and no liver disease The two can be differentiated by the low fasting blood sugar, 50 mg per 100 cc or lower, seen in organic disease Hepatic disease is accompanied by an equally low fasting blood sugar level, but after the administration of glucose the curve shows a high plateau like that seen in diabetes mellitus

The dietary treatment of functional hypoglycemia, originally devised by Waters,[46] was a low carbohydrate diet This was subsequently modified by Conn,[48] who based his treatment upon the observation which he and Newburgh[49] made that in both normal and diabetic persons the ingestion of large amounts of protein is followed by little or no rise in the blood sugar content This they attribute to the slowness and evenness of rate with which the carbohydrate derived from protein is liberated Conn assumes that liberal amounts of ingested protein will supply dextrose to the blood stream at such a consistently slow rate that there will be no stimulation of the insulogenic mechanism, in confirmation of this he points to the almost flat blood sugar curve exhibited by his patients for eight hours after the ingestion of protein He reports surprisingly good results in spontaneous hypoglycemia with a diet which provides 50 to 75 gm of carbohydrate 120 to 140 gm of protein and sufficient fat to bring the caloric intake to the maintenance figure

**Table 77 Sample Low Carbohydrate Menus for Patients with Spontaneous Hypoglycemia**

I

(Carbohydrate 50 gm protein 100 gm fat 145 gm)

Breakfast
- ½ medium sized grapefruit
- 2 shirred eggs
- Average sized slice of broiled ham
- 1½ pieces of zwieback
- 1 square of butter
- Coffee or tea 20% cream

Dinner
- Large helping of roast beef with fat
- ½ cup of Brussels sprouts 1 tablespoonful of cream sauce
- Small salad lettuce tomato cucumber 1 tablespoonful of mayonnaise 2 rounding tablespoonfuls of cottage cheese
- 1 corn muffin with 2 teaspoonfuls of butter
- Snow pudding made with saccharine
- Coffee or tea with 1 tablespoonful of cream if desired

Supper
- 2 medium sized broiled lamb chops
- Average helping of buttered celery

Lettuce salad 1 level tablespoonful of cottage cheese, ½ tablespoonful of Thousand Island dressing
2 Uneeda Biscuits and 1 teaspoonful of butter
Baked custard made with saccharine

Bedtime
1 cup of beef broth

II

(Carbohydrate, 50 gm , protein, 110 gm , fat, 160 gm )

Breakfast
½ small grapefruit
2 slices of broiled ham, 2 by 1 by ¼ inches
3 slices of crisp bacon
1 inch cube of cheese toasted on ½ slice of bread 4 by 2 by ¼ inches
Coffee with 4 tablespoonfuls of 20% cream

Dinner
*Medium sized helping of roast chicken*
Average helping of spinach, 1 teaspoonful of butter
Average helping of mashed turnips, butter
Coleslaw with dressing 1 tablespoonful of chopped tomato, 1 tablespoonful of mayonnaise, 1½ inch cube of American cheese, grated, a bit of onion
1 small corn muffin, 2 teaspoonfuls of butter

Supper
Cheese omelet (3 yolks and 2 whites, 2 tablespoonfuls of grated American cheese, 1 tablespoonful of cream, salt)

III

(Carbohydrate, 50 gm , protein 110 gm fat, 160 gm )

Breakfast
*Fruit cup* orange and grapefruit
Tomato omelet (2 yolks, 3 whites, 3 tablespoonfuls of tomatoes 1 tablespoonful of cream, 1 teaspoonful of butter parsley garnish)
3 strips of crisp bacon
1½ pieces of zwieback with 2 teaspoonfuls of 20% cream
Coffee or tea, 1 tablespoonful of 20% cream

Dinner
Average helping of baked or broiled bluefish 1 tablespoonful of butter with lemon
Baked stuffed tomato (2 oysters chopped pulp of tomato, 1 teaspoonful of butter, seasoning, a few bread crumbs on top)
3 tablespoonfuls of buttered turnips
3 stalks of celery stuffed with 2 tablespoonfuls of American cheese 5 pecans chopped, ½ tablespoonful of mayonnaise
Lemon Jello with saccharine
1 medium sized corn muffin with 1 tablespoonful of butter
Lemonade with saccharine

Supper
Average helping of broiled sweetbreads 1 tablespoonful of butter

boiled egg yolk
spoonful of whipped cream
3 Uneeda Biscuits or 1 piece of zwieback, ½ tablespoonful of butter

## Recipe for Southern Corn Muffins

¾ cup corn meal
¼ cup flour
1 egg
2 tablespoonfuls melted fat
¾ cup buttermilk
½ teaspoonful salt
1½ teaspoonfuls baking powder
¼ teaspoonful soda

Add water to make a thinner batter, if necessary This recipe makes six large muffins, each containing 3 5 gm of protein 6 5 gm of fat and 16 3 gm of carbohydrate and supplying 80 Calories

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43 Wilder, R M, Allan, F N, Power, M H, and Robertson H E Carcinoma of the Islands of the Pancreas Hyperinsulinism and Hypoglycemia J A M A *89* 348, 1927
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45 Conn, J W [illegible] A, *23* 108, 1947
46 Waters, W C, Jr Spontaneous Hypoglycemia, The Role of Diet in Etiology and Treatment South M J *24* 249, 1931
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48 Conn, J W The Advantage of a High Protein Diet in the Treatment of Spontaneous Hypoglycemia J Clin Investigation, *15* 673, 1936
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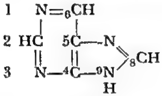
# 16

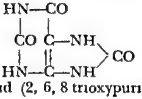
## *Gout*

Gout is a disease of metabolism with heritable tendencies, the salient characteristic of which is a deposition in the tissues of sodium urate This anomaly of purine metabolism does not, however, fully explain the nature of gout, in spite of a vast amount of experimental work, there is much which remains obscure The disease is more common in America than is usually thought Of the 100 cases reviewed by McCracken, Owen and Pratt[1] only 41 had been correctly diagnosed in previous attacks These authors regard gout as a forgotten disease

The offending factor in gout, uric acid, is a member of the group of compounds known as purine These come from cell nuclei, both of the body cells and of those obtained from plant and animal food



Purine



Uric acid (2, 6, 8 trioxypurine)

It was formerly thought that uric acid was developed only from pre formed nucleoprotein or purine and that it came from two sources from a breaking down of the body tissues the endogenous purines and from the nucleoproteins of the food the exogenous purines This distinc tion now loses its significance for it has been discovered that uric acid is synthesized within the body at a vigorous rate from the simplest carbon and nitrogen compounds[2] Nucleic acid is not necessarily its precursor It can be formed from metabolites of ingested carbohydrate, protein, and fat as well as from preformed purine

The fate of uric acid in the body is difficult quantitatively to follow, because varying amounts are stored in the tissues It is believed by some to be an end product of purine metabolism but Folin and his associates[3] demonstrated in their experiments on dogs its destruction in the body It appears therefore, that in man uric acid is in small part destroyed and in larger part stored for variable periods in the tissues, while the remainder circulates in the blood ultimately to be excreted by the kidneys

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# 16

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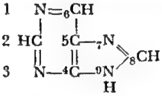
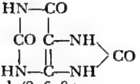
The offending factor in gout, uric acid, is a member of the group of compounds known as purine. These come from cell nuclei, both of the body cells and of those obtained from plant and animal food.



Purine



Uric acid (2, 6, 8 trioxypurine)

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The fate of uric acid in the body is difficult quantitatively to follow, because varying amounts are stored in the tissues. It is believed by some to be an end product of purine metabolism, but Folin and his associates[3] demonstrated in their experiments on dogs its destruction in the body. It appears, therefore, that in man uric acid is in small part destroyed and in larger part stored for variable periods in the tissues, while the remainder circulates in the blood, ultimately to be excreted by the kidneys.

The uric acid of the blood is greater in gouty than in nongouty persons Using the method of Folin,[4] Jacobson[5] found for the blood of 100 persons living on a mixed diet, uric acid values during fasting which ranged from 1 9 to 6 7 mg per 100 cc, with a mean of 4 2 mg In twenty-one cases of gout the uric acid values, determined repeatedly under various conditions, ranged from 5 2 to 14 8 mg per 100 cc of serum In 94 per cent of the determinations these figures exceeded 7 mg The conclusion, however, of Brøchner Mortensen[6] and of other writers is that there is no correlation between the degree of hyperuricemia and the severity of the gout Other diseases, notably chronic nephritis, are sometimes accompanied by an increase in the urate content of the blood, but a high uric acid value for the blood always suggests gout

The urine of the gouty person, unlike the blood, is generally believed to show a low content of uric acid This is denied, however, by Talbott and Coombs,[7] whose studies indicate that youthful gouty patients who have experienced no renal damage are well able to excrete water and solids and to concentrate uric acid Those who showed a low output of uric acid between attacks were older persons with obviously damaged kidneys In another series of studies Talbott and his associates[8] found that diuresis begins before any clinical or subjective evidence of acute gout is manifest and that accompanying this there is a negative sodium and chloride balance Simultaneously there is also an increased secretion of potassium calcium, ammonia, titratable acid, phosphate and urate

### THE NATURE OF GOUT

The underlying cause of the metabolic disturbance which leads to an increase in the uric acid content of the blood and the deposition of sodium urate in the tissues is unknown Indeed, there is some question whether these manifestations, striking as they are, should be regarded as the most significant feature of the disease One theory, discussed by Hench,[9] is that abnormalities of purine metabolism are the result rather than the cause of the disease and that the deposition of urate is a minor effect of remote changes in which other toxic bodies of more profound influence are produced It has also been suggested that the ultimate cause is a cellular sensitization to certain proteins of pathologic origin, a form of allergy Folin[3] and his associates suggested that impairment of a selective excretory function of the kidney as regards uric acid is the underlying fault, but others regard kidney impairment merely as an important secondary factor It is possible that the true explanation may be found in a combination of the last two theories and that, as Grabfield[10] suggests the cause may lie in functional disturbances of the vegetative nervous system in which the altered innervation of the kidney is a significant feature

Opposed to this is the view of Talbott and Coombs,[7] whose studies lead them to state that in the earlier years, after the onset of articular symptoms, gouty patients show no constitutional inferiority of the kidneys in respect to the excretion of uric acid They believe that any inferiority which may be demonstrated later is related to renal damage

acquired through prolonged and excessive excretion of uric acid The data accumulated by these authors lead them to look upon increased formation rather than decreased elimination of uric acid as a fundamental feature of the disease What underlies this is unknown

### THE RECOGNITION OF GOUT

To recognize gout is not difficult if one is on the lookout for it In the experience of recent writers it is more frequently seen in private than in clinic practice The victim is usually of middle age, robust in appearance and more or less overweight He frequently gives a family history of gout

Considerable light is thrown upon the diagnosis of this disease by the studies of Hench and his associates[11] who made a comparative study of 100 cases each of gout, rheumatic fever and infectious arthritis They state that gout is so variable in its manifestations and the appearance of objective signs is subject to such delay that the symptoms are seldom helpful As a basis for an early diagnosis, they regard the characteristic clinical history as most satisfactory Except in chronic gout the course of this disease differs from that of the other forms of arthritis studied in the paroxysmal and intermittent character of its acute attacks and in the periods of complete remission This is in close agreement with the experience of Herrick and Tyson[12] The metatarsal joints are most often affected, and next in frequency the knee and toe joints Roentgenograms of these joints frequently reveal no abnormality

Chronic gout is less characteristic, for it often exhibits all the appearances of other forms of chronic polyarthritis Inflammation of the joints is more or less permanent, and there is often deformity There may be leukocytosis The history of attacks of acute gout is significant

Other criteria for the diagnosis of gout are a high uric acid content of the blood, increased sedimentation rate and the presence of tophi The uric acid content of the blood is usually, though not invariably, elevated, being above 5 mg per 100 cc Tophi which appear near the outer margin of the helix of the ear as small, rounded collections of urate are particularly characteristic, as are the large tophi of chalk like material which in chronic gout appear on the metatarsophalangeal joint of the great toe Tophi, however, are not always present

### DIET

Present day conceptions of the proper diet in gout have been radically altered by the recognition that uric acid is derived from simple carbon and nitrogen compounds as well as from preformed purines The mere elimination of nucleoproteins from the diet does not accomplish all that was once believed Nonetheless, it is still thought that patients with chronic gout and those with frequent acute exacerbations would do well to restrict the intake of both purines and proteins On this assumption the diet should adhere to the following specifications (1) In total caloric value it should be slightly (10 or 15 per cent) below the calculated normal, any approach to obesity should be avoided (2) It

should be relatively free of purines the necessity for an absolutely purine free diet is questioned A purine ingestion of 100 mg daily is admissible (3) *It should be low in fats* because fats are thought to inhibit purine excretion (4) It should be relatively rich in carbohydrates because these may tend to promote purine excretion

The acute attack is of such relatively short duration that it is safe to restrict the diet rigidly The patient should be given a relatively purine free diet which provides moderate amounts of protein very little fat and reasonable amounts of carbohydrate This should include small quantities of milk (possibly skim milk), cereals with milk, white bread with a minimum of butter, preserves, fresh fruits and an abundance of lemonade and fruit juices Large quantities of water should be given In short, the food at this time should be not only relatively free from purine and low in fat content, but should also be simple, easily digested and relatively small in amount

*For the interval treatment of symptomless gout*, Hench[13] advises the following dietary regimen The treatment should be individualized and dependent to some extent upon the severity of the disease and the patient's temperament The diet should be purine free on two days (not necessarily consecutive) and poor in purines five days each week

While the normal diet carries from 600 to 1000 mg of purines the low purine diet as devised by Hench provides only 100 to 150 mg of purines This regimen can be attained by allowing one food from list 2 of Table 78 one day, and one from list 3 four days a week Articles from list 4, except tea and coffee, may be chosen without restriction in amounts sufficient to provide the desired caloric intake, two days each week the food should be chosen only from this list The foods in list 1, which contain very large amounts of purine bodies, should be avoided entirely

Rich, highly seasoned foods should be avoided The experience of many gouty patients has shown that violation of this rule will often precipitate an acute attack The meals should be simply prepared and should be taken at regular hours

Caffeine belongs in the purine group and even though it is probably not convertible into uric acid, it should largely be avoided It is best that the patient with gout drink no tea or coffee or at most one small cup of coffee for breakfast Alcoholic beverages are supposedly harmful but for those who are accustomed to take a little alcohol with their dinner and who persist in this practice, well diluted whiskey is best

**Table 78 Purine Content of Certain Foods* (Hench[1])**

| | | | | | |
|---|---|---|---|---|---|
| List 1 | Foods which contain very large amounts (150 to 1000 mg) of purine bodies in 100 gm | | | | |
| | Sweetbreads | 825 mg | Kidneys (beef) | 200 mg |
| | Anchovies | 363 mg | Brains | 195 mg |
| | Sardines (in oil) | 295 mg | Meat extracts | 160 400 mg |
| | Liver (calf beef) | 233 mg | Gravies | Variable |
| List 2 | Foods which contain a large amount (75 to 150 mg) of purine bodies in 100 gm | | | | |

**Table 78 Purine Content of Certain Foods—*(Continued)***

List 3 Foods which contain a moderate amount (up to 75 mg) of purine bodies in 100 gm

Asparagus bluefish bouillon cauliflower chicken crab eel finnan haddock ham herring kidney beans lima beans lobster mushrooms mutton navy beans oatmeal oysters peas salmon shad spinach tripe tuna fish whitefish

Also whole grain bread and breadstuffs graham bread graham crackers oat meal crackers rye bread Rye Krisp whole wheat bread Zed

Also whole grain cereals Bemax bran flakes cracked wheat Embo graham porridge Grapenuts Krumbles malt breakfast food Pep Bran Flakes Pettijohns Puffed Wheat Ralston s Sims Shredded Wheat Wheaties Wheat Oats Wheatsworth Whole Wheat Krumbles

List 4 Foods which contain an insignificant amount of purine or no purine

1 Beverages
- Carbonated
- Chocolate
- Cocoa
- Coffee
- Fruit juices
- Postum
- Tea

2 Butter†

3 Breads and breadstuffs (except whole grain under 1 st 3)
- Benson s water crackers
- Butter thins
- Corn bread
- Corn sticks
- French bread
- Gluten bread
- Holland rusk
- Soda crackers
- Uneeda biscuit
- Water rolls
- White bread
- Zwieback

4 Caviar

5 Cereals (except whole grain under list 3)
- Breakfast brownies
- Cornflakes
- Cream of Wheat
- Farina
- Grits
- Post Toasties
- Puffed Rice
- Rice Flakes
- Rice Krispies
- White cornmeal
- Yellow cornmeal

6 Miscellaneous cereal products
- Arrowroot
- Hominy
- Macaroni
- Noodles
- Sago
- Spaghetti
- Tapioca
- Vermicelli

7 Cheese of all kinds†

8 Eggs

9 Fats of all kinds (but eat in moderation) †

10 Fruits of all kinds

11 Gelatin

12 Milk
- Buttermilk
- Condensed milk
- Malted milk

13 Nuts of all kinds†
- Peanut butter†

14 Pies (except mincemeat) †

15 Shad roe

16 Sugar and sweets

17 Vegetables
- Artichokes
- Beets
- Beet greens
- Broccoli
- Brussels sprouts
- Cabbage
- Carrots
- Celery
- Corn
- Cucumber
- Dandelion greens
- Eggplant
- Endive
- Kohlrabi
- Lettuce
- Okra

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* To calculate the purines or purine bodies in a given food the purine nitrogen is multiplied by 3 example 200 mg of purine nitrogen equals 600 mg of purine bodies

† These foods are high in fat

Table 78 Purine Content of Certain Foods—(*Continued*)

| | | |
|---|---|---|
| 17 Vegetables (*continued*) | | 18 Vegetable and cream soups (to be made with allowed vegetables and without meat stock) |
| Parsnips | Summer squash | 19 *Vitamin concentrates* |
| Potato sweet | Swiss chard | Cod liver oil |
| Potato white | Tomato | *Halibut oil* |
| Pumpkin | Turnips | Yeast |
| Rutabagas | | |
| Sauerkraut | | |
| String beans | | |

Water should be taken in abundance Mineral waters have no virtue not inherent in any good table water Alkaline waters are possibly harmful Yeo[14] attributes the benefits to be derived by the gouty patient from a visit to a spa to the following factors

(1) The quantity of water *more or less pure taken into the body under regulated* conditions daily (2) The altered mode of life the regular exercise in the open air the modified diets *the early hours the absence of business cares* (3) *In many foreign spas* there is the drier and hotter Continental climate (4) The stimulating effect to excretion and *tissue change which the baths douches frictions* and manipulations applied at most of them induce

Persistency is essential for after months of dietary restriction when apparently nothing has been accomplished patience is often rewarded by definite improvement Sustained long continued effort should therefore be insisted on There often comes a time however especially in the cases of milder gout when it is desirable to permit a little meat and otherwise to relax the dietary restrictions In this the physician should be guided largely by the height of the uric acid level of the blood and the length of time the patient has been free from gouty manifestations The warning should be given however that a certain amount of dietary control is necessary throughout the remainder of the patient s life

## DRUGS

*Colchicum* has the sanction of long usage Talbott and Coombs[7] found the crystalline form more reliable than the wine or tincture and for acute symptoms they recommend $\frac{1}{120}$ grain (0.0005 Gm) of colchicine every one or two hours until eight twelve or sixteen doses have been taken Hench and his associates[15] quote such statements as No benefit has been derived from colchicine except in patients with gout and no patient with proved gout has failed to be greatly benefited by it and 'We have never seen colchicine fail to give relief These authors state that enough should be prescribed to give relief even if that amount produces diarrhea The onset of nausea vomiting and diarrhea indicates that tolerance has been reached Patients often learn from experience the proper number of pills to take The manner in which colchicum acts is unknown but clinical experience has demonstrated its efficiency

*Salicylates* are believed to be good uric acid eliminants and for patients whose hyperuricemia cannot be cured by diet these drugs may be used Acetylsalicylic acid and sodium salicylate are suitable

*Cinchophen* (or neocinchophen) lowers the value for uric acid in the blood by hastening its excretion it sometimes relieves pain in a graphic

manner Although it will give pronounced relief when administered at the beginning of the acute attack, its use during the height of the attack is inadvisable because of the already increased excretion of uric acid at this stage This drug has been regarded as especially useful in chronic gout, since it reduces the size of the tophi and lessens the frequency of the attacks

The usefulness of this drug is greatly impaired by its toxicity Certain persons seem able to take cinchophen with impunity, while others are sensitive to it and are gravely injured by its use even in small doses The toxic effect is exerted chiefly upon the liver Sensitiveness to cinchophen may be natural or acquired, and unfortunately there is no means for recognizing sensitivity in a person until harm has been done Sugg[16] states that toxic cirrhosis due to cinchophen is increasing greatly in frequency Palmer and Woodall [17] after examining the various therapeutic maneuvers designed to mitigate its dangers, conclude that there is no safe method for the administration of cinchophen

Adrenocorticotrophic hormone (ACTH) is said to effect a rapid and satisfactory response in the local and systemic manifestations of acute gout, but Gutman and Yu[18] do not regard it as convincingly superior to colchicine These physicians do not consider this agent feasible or desirable in the prevention or treatment of chronic tophaceous gout

Table 79 Menus for Patients with Gout

| Purine Free Foods | Protein (Gm) | Calories (Approximate) |
|---|---|---|
| I Monday | | |
| Breakfast | | |
| 1 ripe pear | 1 | |
| 2 tablespoonfuls of Cream of Wheat 1 teaspoonful of sugar 2 tablespoonfuls of cream | 1 | |
| 1 shirred egg | 6 | |
| 1 whole wheat muffin 1 teaspoonful of butter | 3 | |
| 1 cup of Postum with 1 teaspoonful of sugar 1 tablespoonful of 4% cream | 1 | |
| | 12 | 550 |
| Dinner | | |
| Cream of tomato soup 1 cracker | 4 | |
| 3 tablespoonfuls of mashed potatoes | 4 | |
| Rice pudding | 6 | |
| 1 slice of bread 1 teaspoonful of butter | 3 | |
| 1 glass of milk | 7 | |
| | 24 | 800 |
| Supper | | |
| 1 egg omelet with jelly 1 teaspoonful of butter | 6 | |
| 1 tablespoonfuls of hominy grits 1 teaspoonful of butter | 2 | |
| Average helping of congealed fruit salad cream dressing | 2 | |
| 1 slice of toast 1 teaspoonful of butter | 3 | |
| 1 glass of milk | 7 | |
| | 20 | 750 |
| | 56 | 2100 |

Table 79 Menus for Patients with Gout—*(Continued)*

| | Protein (Gm) | Calories (Approximate) |
|---|---|---|
| II Tuesday | | |
| Breakfast | | |
| Baked apple 2 tablespoonfuls of farina 2 tablespoonfuls of sugar 2 tablespoonfuls of cream | 4 | |
| 1 poached egg on toast 1 teaspoonful of butter | 9 | |
| 1 popover with 1 teaspoonful of butter, 1 tablespoonful of jelly | 3 | |
| 1 cup of Postum hot water or tea cream and sugar | 1 | |
| | 17 | 650 |
| Dinner | | |
| Individual scalloped potato (1 medium sized potato ¼ cup of milk 2 teaspoonfuls of butter 1 teaspoonful of flour) | 4 | |
| Steamed okra and tomatoes | 3 | |
| Brussels sprouts 1 teaspoonful of butter | 1 | |
| Apple and carrot salad 1 tablespoonful of mayonnaise | 1 | |
| 1 corn muffin 1 teaspoonful of butter | 3 | |
| 1 glass of milk | 7 | |
| | 19 | 850 |
| 4 P M | | |
| 1 glass of orange juice | | |
| Supper | | |
| Cream of rice soup | 9 | |
| Eggs à la goldenrod | 11 | |
| Baked tomato stuffed with bread crumbs (½ slice of toast) tomato pulp 1 teaspoonful of butter | 3 | |
| Pear salad with 1 tablespoonful of cottage cheese 1 teaspoonful of mayonnaise | 3 | |
| 1 slice of toast 1 teaspoonful of butter | 3 | |
| 1 glass of milk | 7 | |
| | 36 | 1150 |
| | 72 | 2650 |
| III Wednesday | | |
| Breakfast | | |
| ½ grapefruit | 2 | |
| 1/6 cup of corn flakes or other dry cereal with | 1 | |
| sugar and ⅓ glass of rich milk | 2 | |
| 2 popovers 1 tablespoonful of butter 1 tablespoonful of preserves | 6 | |
| 1 cup of Postum hot water or tea 2 tablespoonfuls of cream 2 teaspoonfuls of sugar | 1 | |
| | 12 | 650 |
| Dinner | | |
| Baked potato with 1 tablespoonful of butter | 4 | |
| Buttered parsnip | | |
| 1/6 small avocado 1 teaspoonful of grated onion 1 teaspoonful of oil and lemon juice | 1 | |
| Tapioca pudding with fruit sauce | 3 | |
| 2 slices of bread 1 tablespoonful of butter | 6 | |
| | 14 | 950 |
| 4 P M | | |
| 1 glass of milk | 7 | |

Table 79 Menus for Patients with Gout—*(Continued)*

| | Protein (Gm) | Calories (Approximate) |
|---|---|---|
| Supper | | |
| Cream of potato soup 2 crackers | 4 | |
| Average helping of stewed tomatoes | 1 | |
| 1 tablespoonful of beet and egg salad 1 tablespoonful of mayonnaise | 7 | |
| Prune soufflé | 3 | |
| 2 slices of toast 2 teaspoonfuls of butter | 6 | |
| 1 glass of milk | 7 | |
| | 35 | 1050 |
| IV Thursday | | |
| Breakfast | 61 | 2650 |
| 1 glass of orange juice | | |
| 2 tablespoonfuls of oatmeal 1 teaspoonful of sugar 2 tablespoonfuls of 2% cream | 4 | |
| Scrambled egg ¼ teaspoonful of butter | 6 | |
| 2 slices of toast 1 tablespoonful of butter | 6 | |
| Postum with sugar and cream | 1 | |
| | 17 | 700 |
| 10 A M | | |
| 1 glass of milk | 7 | |
| Dinner | | |
| Average helping of simply cooked spaghetti and tomato | 5 | |
| Average helping of steamed young string beans (diagonal) 1 teaspoonful of butter | 1 | |
| Average helping of buttered carrots 1 teaspoonful of butter | 1 | |
| Cucumber and tomato salad on leaf lettuce 1 teaspoonful of mayonnaise | 2 | |
| 1 corn muffin 1 teaspoonful of butter | 3 | |
| Apple whip (2 tablespoonfuls of apple sauce 1 egg white) 1 tablespoonful of whipped cream | 6 | |
| 4 P M | 17 | 900 |
| Lemonade or limeade | | |
| Supper | | |
| Creamed egg on toast | 11 | |
| Baked banana buttered nuts | 1 | |
| Peach salad with 1 tablespoonful of cottage cheese 1 teaspoonful of cream dressing | 3 | |
| 1 glass of milk | 7 | |
| 1 slice of bread and 1 teaspoonful of butter | 3 | |
| | 25 | 750 |
| V Friday | 66 | 2350 |
| Breakfast | | |
| Fresh fruit in season | 1 | |
| 4 tablespoonfuls of Cream of Wheat | | |
| 2 teaspoonfuls of sugar and 4 tablespoonfuls of cream | 5 | |
| Creamed toast | 5 | |
| 1 slice of toast 1 teaspoonful of butter | 3 | |
| Postum with sugar 2 tablespoonfuls of cream | 1 | |
| | 15 | 700 |
| 10 A M | | |
| Grapes | 1 | |

Table 79 Menus for Patients with Gout—*(Continued)*

| | Protein (Gm) | Calories (Approximate) |
|---|---|---|
| **Dinner** | | |
| Brussels sprouts en casserole (recipe as for cauliflower) | 5 | |
| Average helping of mashed potatoes | 3 | |
| Average helping of beet suprême | 2 | |
| Fruit salad with 1 tablespoonful of cream dressing | 1 | |
| Rice custard | 6 | |
| ½ glass of tomato juice | | |
| 1 corn muffin 1 teaspoonful of butter | 3 | |
| | 20 | 700 |
| **4 P M** | | |
| 1 glass of buttermilk | 6 | |
| **Supper** | | |
| Cream of corn soup | 4 | |
| Baked tomato stuffed with rice | 5 | |
| Baked apple with small lettuce salad lemon juice | 3 | |
| 2 tablespoonfuls of boiled custard | | |
| 2 small slices of toast or 1 muffin 1 teaspoonful of butter | 2 | |
| 1 glass of milk | 7 | |
| | 21 | 850 |
| **VI Saturday** | 63 | 2250 |
| **Breakfast** | | |
| Ripe banana with 1 teaspoonful of sugar 2 teaspoonfuls of cream | 2 | |
| 1 Shredded Wheat biscuit 2 teaspoonfuls of sugar ½ glass of rich milk | 6 | |
| 1 large whole wheat raisin muffin 1 tablespoonful of butter 1 tablespoonful of orange marmalade | 3 | |
| Postum 2 teaspoonfuls of sugar 2 tablespoonfuls of cream | 1 | |
| | 12 | 900 |
| **10 A M** | | |
| ½ glass of grapefruit juice | 2 | |
| **Dinner** | | |
| Shirred egg with tomato sauce | 6 | |
| Baked stuffed potato butter | 4 | |
| Buttered parsnips | | |
| Cucumber and onion salad oil and lemon juice | | |
| Snow pudding 2 tablespoonfuls of whipped cream | 5 | |
| 1 slice of bread with 1 teaspoonful of butter | 3 | |
| 1 glass of milk | 7 | |
| | 25 | 850 |
| **4 P M** | | |
| Vegetable soup | 3 | |
| **Supper** | | |
| Cream of tomato soup croutons | 2 | |
| Baked or mashed Hubbard squash | 1 | |
| Egg and beet salad with 1 tablespoonful of mayonnaise | 7 | |
| Prune soufflé | 3 | |
| 2 whole wheat raisin muffins 1 tablespoonful of butter | 6 | |
| 1 glass of milk | 7 | |
| | 26 | 950 |
| | 68 | 2700 |

Table 79 Menus for Patients with Gout—(*Continued*)

| | Protein (Gm) | Calories (Approximate) |
|---|---|---|
| **VII Sunday** | | |
| **Breakfast** | | |
| Ripe pear | | |
| 3 tablespoonfuls of cracked wheat 1 teaspoonful of sugar, 1/3 glass of thin cream | 6 | |
| 1 scrambled egg with tomato | 6 | |
| 2 small slices of toast 1 teaspoonful of butter | 6 | |
| Postum or Kaffee Hag 2 teaspoonfuls of sugar 1 oz of cream | 1 | |
| | 19 | 900 |
| **Dinner** | | |
| 2 heaping tablespoonfuls of macaroni and cheese | 19 | |
| 2 heaping tablespoonfuls of mashed turnips | | |
| Buttered beets or dandelion greens | 2 | |
| Congealed fruit salad 2 olives 1 tablespoonful of cream dressing | 2 | |
| 1 white roll 1 teaspoonful of butter | 2 | |
| 2 heaping tablespoonfuls of ice cream | 5 | |
| 1 glass of milk | 7 | |
| | 37 | 1350 |
| **4 P M** | | |
| 1 glass of lemonade or limeade | | |
| **Supper** | | |
| 1 egg souffle | 6 | |
| 2 tablespoonfuls of creamed celery | 1 | |
| 2 halves of peaches 2 tablespoonfuls of whipped cream | 2 | |
| 1 Vienna roll 1 teaspoonful of butter | 4 | |
| 1 glass of milk | 7 | |
| **Bedtime** | | |
| 1 glass of buttermilk | 6 | |
| | 26 | 1000 |
| | 82 | 3250 |

## Purine Free Recipes

| | | |
|---|---|---|
| **Cauliflower en casserole** | | |
| 2 heaping tablespoonfuls boiled cauliflower | | |
| 1 teaspoonful butter | | |
| 1 teaspoonful cheese | | |
| 1 teaspoonful cracker | | |
| Juice of cauliflower | | |
| Put in individual casserole season and sprinkle with cheese and crumbs Contains | 5 | 155 |
| **Cheese dream** | | |
| 1 oz cheese (American preferred) | | |
| 2 medium sized slices bread | | |
| 2 teaspoonfuls butter | | |
| Butter bread slice cheese put between bread and toast both sides in oven Contains | 15 | 365 |
| **Potato au gratin** | | |
| 1 medium sized boiled potato | | |
| 2 teaspoonfuls dry grated cheese | | |
| 1/4 glass milk | | |
| Bake in individual dish each containing | 12 | 261 |

Purine Free Recipes—*(Continued)*

Tapioca pudding
2 cups milk
1 egg
3 tablespoonfuls Minute Tapioca
2 tablespoonfuls sugar
3 heaping tablespoonfuls contains 6 172

Rice custard
1 cup boiled rice
2 eggs
1¼ cups milk
2 heaping tablespoonfuls contain 6 179

Soft custard
1 egg yolk
½ cup milk
1 heaping tablespoonful sugar
4 tablespoonfuls contain 4 131

Snow pudding
¾ cup water
1 heaping teaspoonful gelatin
1 teaspoonful lemon juice
Lemon rind
White of 1 egg
2 heaping tablespoonfuls contain 5 67

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# 17

## *Obesity and Leanness*

### OBESITY

*Obesity is a condition of the body in which the weight* because of the excessive storage of fat, is above normal The exact point at which obesity begins is difficult to define, but as a general rule it can be said that a weight which is more than 10 per cent above the fixed standard may be regarded as abnormal Tables of standard weights will be found at the end of this book (Appendix, Tables 131 136)

#### Classification of Obesity

The classification of fat persons suggested by Ebstein is not bad "those who inspire envy, those who provoke laughter, and those who call forth sympathy" In America, however, the fashion for thinness is such and properly so, that the first group does not exist Pathogenesis is the logical basis for classification, but there is so much doubt as to the ultimate nature of obesity that any grouping made today on this *basis must be merely tentative With this reservation the following* classification is offered

A Simple obesity
B Obesity which accompanies other disorders
  1 Pituitary
  2 Gonad
  3 Adrenal cortex
  4 Thyroid

**Simple Obesity.** Simple or alimentary obesity comes from the indulgence of appetite plus a good digestion The wonder *is not that a few* persons become obese, but rather that so many without apparent effort are able year after year to maintain an unchanging weight Without giving much thought to what he eats or how he lives, the average young adult throughout a period of years varies hardly a pound in weight *Subconsciously, when he* eats too much he feels the need for more exercise and takes it or if his activities are restricted, the desire for food is lessened Apparently the normal person is in possession of some form of regulatory mechanism which balances appetite against desire for physical exertion, by means of which he maintains body weight In alimentary obesity this mechanism fails to synchronize The person

eats too much or exercises too little, or both, and, absolutely or relatively, his intake of food is too great He may take an amount of food which under ordinary circumstances would be regarded as appropriate, but if he is lazy, sleeps too much and takes little or no exercise, then this amount becomes excessive The records of 350 cases of obesity studied by Greene[1] indicated that in 67 5 per cent of these, inactivity occurred simultaneously with gain in body weight and that in only 3 2 per cent was there a history of increased food intake In the majority of instances, however, both causes, too little exercise and too much food, are probably operative

As age advances, however, the efficiency of this hypothetical regulatory mechanism is lost At thirty years of age a person is as a rule about 10 pounds heavier than at twenty years, again at forty or forty five another 10 or 12 pounds have been added This tendency which is of such frequent occurrence that it is commonly regarded as physiologic, may be an accompaniment merely of the contentment and relaxation which come with middle age, of diminished exercise, or of a slowing down for unknown reasons of general metabolic activity (See p 12)

*Habit,* example or custom, by influencing the appetite, may be the controlling factor in alimentary obesity and lead insidiously to a constant though perhaps small dietary overloading An intake of food only slightly in excess of the body needs if continued through months and years by a person with a tendency toward obesity, will occasion the deposition of considerable fat

*Emotional factors* are believed to be the dominating influence in many cases of obesity[2] The person is frustrated, dissatisfied in life, or for other reasons is unhappy, and as a compensatory measure he tries to find satisfaction in eating As a result he eats too much If, however, such a person has the strength of character for a time to deny himself and to change his dietary habits it is surprising how readily his appetite will readjust itself and permit him to remain comfortable upon a more appropriate regimen

**The Question of Constitutional Obesity** This type of obesity is claimed to be the result of some anomaly of metabolism or other physiologic aberration which favors the abnormal accumulation of fat, but its existence is not generally recognized Most students of nutrition among them Newburgh and his associates[3] believe that the fundamental cause of such obesity is to be found not in any form of metabolic error, but rather in the fact that these persons in common with all obese persons, are the victims solely of a perverted appetite They hold that all fat persons are alike in one respect they literally overeat Emphasizing the importance of water balance these authors hold that the initial failure to lose weight when the actual caloric intake is less than the calculated maintenance requirement is invariably due to retention of water and that if undernutrition is continued long enough the expected loss in weight will surely follow In his excellent comprehensive review Newburgh[4] cites many painstaking investigations of the metabolism of obese persons and concludes that none of these disclose any abnormal process that accounts for the accumulation of

fat Writing from the same clinic, Conn[5] offers additional evidence in support of the thesis that obesity is invariably the result of an over all intake of energy which has exceeded the total output, that is, a positive energy balance The fundamental fault is to be found in the cause or causes of an excessive desire for food

After all has been said about overeating and the disturbing influence of water balance, much remains, however, as Wilder[6] remarks, still to be explained Why, he asks, in certain cases does fat accumulate selectively in certain regions of the body? Why is the fat of lipoma so resistant to withdrawal during starvation? And why, during starvation, is there so much greater loss of fat from the thin upper half of the body than from the fat legs and buttocks?

Some qualitative anomaly—some disturbance in the intricate mechanism which normally controls metabolism—has been assumed by Bauer,[7] who uses the term "lipophilia" to indicate a special tendency to deposit fat as well as a special resistance to the mobilization of fat from adipose tissue This lipophilic tendency is assumed to reside in the genes of the organism and is expressed normally in those tissues which ordinarily accumulate fat

An attractive theory was developed by Hetenyi[8] when he reported that, no matter what the diet, the lipids of the blood tend to assume a lower level in obese than in normal persons This author's observations indicate that in obese persons there is an abnormally rapid withdrawal of fat from the circulation with an accelerated deposition in the tissues, and that the converse is also true that the withdrawal of fat from the fat deposits of the obese person is resisted In discussing the clinical implications of these observations Wilder[6] suggested that the early withdrawal of fat from the circulation possibly explains the delayed sense of satiety and the abnormal desire for carbohydrate frequently experienced by obese persons If part of the nourishment is thus made less available for metabolism while energy requirements remain the same, then hunger is inevitable, more food is eaten than otherwise would be required, and the result is a gain in weight

Heredity is also believed to be the cause of constitutional obesity It is sometimes suggested that example and the kind of food served at the family table rather than actual heredity are at fault, but apparently the cause is deeper In scrutinizing the progeny of a group of obese women, Gurney[9] saw evidences of segregation, which he believes indicate a mendelian inheritance of build, and upon this basis he attempted tentatively to explain the apparent inconsistencies of build often seen in persons subject to the same environmental influence Such an inheritance may be one of metabolic aberration, or, as Wilder suggests it may represent merely an irritability of certain centers in the diencephalon, where the feelings of hunger and of satiety originate A lesion in this region often results in great gain in weight, and since differences in sensitivity may vary within physiologic range in normal persons the suggestion is made that the characteristic of increased sensitivity in this region, producing a sensation of hunger, may be passed from parent to child, as are other forms of sensitiveness According to this theory,

delayed satiety is the inherited characteristic and obesity the result. Regardless of these opposing views, the evidence is overwhelming that for obesity to exist the caloric intake must exceed the caloric expenditure.

For complete discussions of the two opposing views of the nature of obesity the reader is referred to the article of Bauer[7] and the reviews of Newburgh,[4] Conn,[5] and Rynearson and Gastineau.[10]

**Obesity Related to Disease.** Several diseases are accompanied by a gain in body weight. In some cases this is due merely to a disturbance in water balance, but in other instances there is genuine accumulation of fat which is not only abnormal in amount, but also bizarre in distribution. The precise nature of the metabolic disturbances which lead to such accumulations of fat is unknown, but it is significant that all the recognized disorders of this type are believed to be related to some derangement of the glands of internal secretion. Such derangements are seldom limited to one gland; they are as a rule multiple and are correspondingly difficult accurately to define. In many and perhaps in all of these disorders an important role, direct or contributory, can be ascribed to the pituitary gland.

*Pituitary obesity* is characterized by large accumulations of fat in the middle of the body—the abdomen, the upper part of the arms, the buttocks and the thighs. The face, forearms and lower part of the legs, including that part of the thigh just above the knee, remain thin. There is also lack of skeletal development, as is evident in the short bones and the small hands and feet, with poor development of the genital organs and absence of the secondary sexual characteristics. Patients with a *basophilic adenoma of Cushing*, who belong in this group, show characteristic accumulation of fat in the face, neck and trunk with hirsutism, sexual dystrophy and possibly kyphosis.

*Gonadal obesity* has similar characteristics. The distribution of fat is similar, being limited largely to the breasts, the sides of the body and the upper, outer third of the thigh. If the disorder began relatively early in life, the patient also exhibits characteristically long extremities.

*Tumors of the adrenal cortex*, developing in childhood, cause characteristic deposits of fat similar to those of pituitary disease; premature sexual development occurs, as well as other symptoms pointing more directly to the adrenal cortex.

*Thyroid obesity* is accompanied by evidences of hypothyroidism, notably the characteristic dry, lifeless skin, pallor and low basal metabolism; the fat is fairly well distributed over the entire body.

Dietary regulation is regarded by some as of little value in the treatment of these disorders, but Evans and Strang[11] believe otherwise. Through drastic dietary restriction they have accomplished benefit even in cases of obesity of endocrine origin.

## Prevention of Obesity

There are groups of persons upon whom it is incumbent to remain thin: those who have a diabetic tendency or whose family history tells of this disease, and those who are chronic sufferers from heart disease,

*nephritis or gout* Persons so handicapped must remain thin if they would be comfortable and have fair assurance of experiencing normal life expectancy

The prevention of obesity requires the same type of caloric restriction though not in so rigid a form, as does its cure Caloric intake should be guided by body weight Dietary fat should be reduced The eating of cereals and bread should also be held within rather narrow limits Milk should always be permitted, even if it is necessary to take it skimmed The eating of freakish diets, consisting largely of such bizarre articles as pickles, is always a mistake, as is also the custom of omitting breakfast The rule should be to eat three meals daily that are reasonably *restricted and simply planned, with due regard for the* ordinary laws of nutrition

Dietary habits which are ill advised should be corrected, particularly the custom of eating rich foods, too much bread and butter, and too many sweets Such habits are unconsciously acquired from close associates or members of the family, but if the patient is willing to make the effort, their correction is not difficult Abstemious habits once developed, can as a rule be continued with entire satisfaction

### Indications for Reduction

For reasons of health, as well as of looks the person whose body weight exceeds the normal by 20 per cent or more should endeavor to reduce This does not of necessity apply to persons who are only slightly *(10 or 15 per cent) above the ideal* unless they are handicapped also by heart disease or a tendency, latent or manifest to such metabolic disorders as gout or diabetes Persons of the last mentioned group should endeavor to remain always a *few pounds underweight*

The reasons for advising weight reduction in the average case are many (1) Life expectancy, as shown by actuarial tables as well as by clinical experience, is greater if with advancing years the person remains thin [9a] (2) The dangers of disease notably the hazards of acquiring diabetes or of succumbing to an operative procedure, are distinctly less in a thin person (3) A condition of overweight in the presence of transient tachycardia increases enormously the hazard of subsequent sustained hypertension [12] (4) Advanced arteriosclerosis is more common in obese persons than in those whose weight is normal [13] (5) Too much fat interferes materially with physical activity and reduces muscular efficiency (6) Obesity handicaps the heart by increasing the load to be carried, while at the same time, because of the collections of fat in and around this organ it interferes with the efficiency of its contraction (7) *Deposits of fat* in the abdominal cavity interfere with movements of the diaphragm and abdominal muscles (8) Extensive deposits of fat in the skin impair its function of regulating heat loss and maintaining body temperature *These influences* place a great handicap upon the obese person and it is chiefly for their relief that his weight should be reduced

## Treatment of Obesity

The adequate treatment of obesity includes effective dietary therapy re-education of the patient as to eating habits and recognition and correction, when possible of any underlying disturbance which may contribute to the disease It is especially important to provide psychiatric guidance for many obese patients for without this the effort to alter permanently their eating (or drinking) habits may be futile

The obese person s weight can be reduced by forcing him to burn his own body fat This is accomplished only through producing a negative energy balance The most effective treatment is merely to reduce the caloric intake below the output by a sufficient amount and for a sufficiently long time

Exercise is of little value in such a regimen because in the obese subject strenuous exercise may be impossible contraindicated or distasteful In addition exercise emphasizes the caloric deficit to the patient through aggravating the sensation of hunger and thereby renders more attractive the breaking of the rules of the diet

Any effect of fluid restriction or low salt regimens on weight reduction of the obese patient is due entirely to the influence of such regimens on water loss They do not promote the burning of the excessive tissue fat and accordingly are not effective in the treatment of obesity Obviously if the fluid restricted by such a regimen is a potent source of Calories (such as beer or carbonated soft drinks) the restriction will improve the effectiveness of a low Calorie schedule! Otherwise it is quite without value

Drugs designed to stimulate metabolism act merely by increasing the disproportion between caloric intake and consumption They are unnecessary and in some instances distinctly dangerous In our judgment thyroid should be given only in association with a reduction regimen when it is clearly indicated by metabolic disturbance and would be prescribed regardless of the need to lose weight Other metabolic stimulants such as dinitrophenol are toxic and should not be given The use of the latter has been clearly linked with the development of cataracts in man and experimental animals

The appetite depressant drugs again are efforts to increase the disproportion between caloric consumption and expenditure by acting through depression of appetite (decrease in food consumption) These preparations are unnecessary in our experience although they are prescribed with enthusiasm by some physicians

**Low Calorie Diets** In precise metabolic studies on obesity one can predict with accuracy the expected weight loss which will follow a given caloric deficit Such studies have established firmly our concepts of obesity but the degree of mathematical precision entailed in these regimens of dietary management is unnecessary in the usual practice of medicine Furthermore the precision of control of dietary intake is seldom practical outside of a rigidly maintained hospital unit

It is our opinion that a caloric reduction which results in a weight loss of 6 to 8 pounds per month may be effected with a minimum of

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The obese person s weight can be reduced by forcing him to burn his own body fat This is accomplished only through producing a nega tive energy balance The most effective treatment is merely to reduce the caloric intake below the output by a sufficient amount and for a sufficiently long time

Exercise is of little value in such a regimen because in the obese subject strenuous exercise may be impossible contraindicated or dis tasteful In addition exercise emphasizes the caloric deficit to the pa tient through aggravating the sensation of hunger and thereby renders more attractive the breaking of the rules of the diet

Any effect of fluid restriction or low salt regimens on weight reduc tion of the obese patient is due entirely to the influence of such regimens on water loss They do not promote the burning of the excessive tissue fat and accordingly are not effective in the treatment of obesity Ob viously if the fluid restricted by such a regimen is a potent source of Calories (such as beer or carbonated soft drinks) the restriction will improve the effectiveness of a low Calorie schedule! Otherwise it is quite without value

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It is our opinion that a caloric reduction which results in a weight loss of 6 to 8 pounds per month may be effected with a minimum of

inconvenience to the patient by making use of the principles of dietary planning discussed as 'exchanges' and outlined in Chapter 15 (p 296) The same method may be used to design more restricted diets if this is wished Examples of menus planned on this basis and which supply 800, 1000, 1200, and 1500 Calories daily are given on pages 336 337

In the planning of a reduction diet it is aimed to underfeed by a caloric deficit of 30 to 50 per cent of the calculated intake required for maintenance at the patient's ideal weight Thus, if maintenance is estimated to require 2000 Calories, a reduction diet providing 1200 or 1000 calories may be prescribed Higher levels of intake may result in such gradual weight loss as to discourage the patient

It is well to provide at least 1 0 gm of protein per kilogram of body weight, 1 5 gm may be included if feasible for the particular patient at hand Arguments advanced in favor of high protein reduction diets usually include the effect of protein on the stimulation of metabolism (specific dynamic action). Keeton and Bone,[14] however, found that under the conditions of their experiments there was negligible stimulation of metabolism by food Further, they reported that the large stores of body fat in the obese subject are so readily available for energy that they protected the body nitrogen even in the face of specific nitrogen deficit The chief advantage, therefore, of high protein reduction diets probably lies in their high satiety value

Carbohydrate intake should be set at a level approaching 50 per cent of the Calories in order to provide a palatable, satisfying diet On extremely low caloric intakes the carbohydrate consumed aids in reducing ketosis

Fat is reduced to a near minimum, but its satiety value and physiologic usefulness in small amounts justify retention of some fat in the low caloric diets

The following low calorie diets are designed for use with the list of food exchanges as presented in Chapter 15 (pp 296 298) The selection of basic foodstuffs has been guided by a consideration of the normal dietary pattern with variation in caloric value achieved by varying the exchanges of bread and fat

**Table 80 Daily Menu Patterns for Low Calorie Diets**

| | 800 Calorie | 1000 Calorie | 1200 Calorie | 1500 Calorie |
|---|---|---|---|---|
| Fruit (1 citrus) | 3 servings | 3 servings | 3 servings | 3 servings |
| Milk | 2 cups (skim) | 2 cups (whole) | 2 cups (whole) | 3 cups (whole) |
| Egg | 1 | 1 | 1 | 1 |
| Meat fish, fowl, cheese | 2 servings | 2 servings | 2 servings | 2 servings |
| Vegetables Group A & B | 4 servings | 4 servings | 4 servings | 4 servings |
| Bread or cereal | 2 slices | 3 slices | 4 slices | 6 slices |
| Butter or margarine | 3 pats | 3 pats | 5 pats | 5 pats |

**Table 80 Daily Menu Patterns for Low Calorie Diets *(Continued)***

LOW CALORIE DIETS PLANNED ON THE BASIS OF THE MENU PATTERNS

| | 800 Calorie | 1000 Calorie | 1200 Calorie | 1500 Calorie |
|---|---|---|---|---|
| Breakfast | | | | |
| Fruit | ½ grapefruit | ½ grapefruit | ½ grapefruit | ½ grapefruit |
| Egg | 1, soft cooked | 1, soft cooked | 1, soft cooked | 1, soft cooked |
| Cereal | None | None | None | None |
| Toast | 1 slice | 2 slices | 2 slices | 2 slices |
| Butter or margarine | 2 pats | 2 pats | 2 pats | 2 pats |
| Milk* | * | * | * | * |
| Coffee | Black or with milk | Black or with milk | Black or with milk | Black or with milk |
| Lunch | | | | |
| Bouillon (If desired) | Bouillon | Bouillon | Bouillon | Bouillon |
| Meat, fish poultry, cheese | Cottage cheese | Cottage cheese | Cottage cheese | Cottage cheese |
| Vegetable | Broccoli | Broccoli | Broccoli | Broccoli |
| Vegetable (raw) | Tossed greens with lemon wedge | Tossed greens with lemon wedge | Tossed greens with lemon wedge | Tossed greens with lemon wedge |
| Bread | None | None | None | 1 slice |
| Butter or margarine | None | None | None | 1 pat |
| Fruit | Watermelon | Watermelon | Watermelon | Watermelon |
| Milk* | * | * | * | * |
| Coffee or tea | Without sugar | Without sugar | Without sugar | Without sugar |
| Dinner | | | | |
| Bouillon (If desired) | Chicken broth | Chicken broth | Chicken broth | Chicken broth |
| Meat, fish poultry, cheese | Roast beef | Roast beef | Roast beef | Roast beef |
| Vegetable | Summer squash | Summer squash | Summer squash | Baked potato Summer squash |
| Vegetable (raw) | Lettuce and tomato salad with vinegar | Lettuce and tomato salad *with vinegar* | Lettuce and tomato salad *with vinegar* | Lettuce and tomato salad *with vinegar* |
| Bread | 1 baking powder biscuit | 1 baking powder biscuit | 1 baking powder biscuit | 2 baking powder biscuits |
| Butter or margarine | 1 pat | 1 pat | 1 pat | 2 pats |
| Fruit | Fresh fruit compote | Fresh fruit compote | Fresh fruit compote | Fresh fruit compote |
| Milk* | * | * | * | * |
| Coffee or tea | Without sugar | Without sugar | Without sugar | Without sugar |

*The 2 cups of milk may be divided during the day as best suits the patient

Much is written concerning the desirability of supplementing the reduction diet with vitamins It should be apparent from the diet list that these diets provide adequately of essential nutrients except Calories and that supplementation with vitamin pills or minerals is imposing an unnecessary expense upon the patient

## LEANNESS

Leanness is a condition of the body in which the weight is 15 per cent or more below normal; when extreme, it is called *emaciation.* It is not feasible to distinguish clinically between acute and chronic undernutrition, for there is probably no essential difference. Evans and Strang[15] remarked that when, as frequently occurs, the background for chronic undernutrition is laid in the period of growth in childhood or adolescence, certain anatomic changes occur; but that when the period of underfeeding begins in adult life, the resulting changes are less conspicuous. Otherwise there is no fundamental difference between the two other than in the rate of development. Like obesity, leanness may be exogenous or endogenous in origin.

*Exogenous leanness* depends upon an inadequacy of diet, which may be absolute or relative. Because of lack of appetite or failure of supply the person simply does not eat enough, or he may be so wasteful in his movements and in his expenditure of energy that an intake of food which otherwise would be sufficient becomes under these circumstances inadequate. This probably explains many cases of "inherited" leanness, the inherited characteristic being a nervous temperament, with habits of movement which make for wasteful expenditures of energy. Although frequently accompanied by physical impairment, moderate degrees of leanness are not incompatible with perfect health.

There are two types, the sthenic and the asthenic. The *sthenic* type is represented by a well-defined group of thin persons who possess in greater or less degree the following characteristics: a fairly good musculature, endurance, stamina, normal resistance to disease, a well-balanced nervous system and emotional poise. The body structure, musculature and nervous system are all good; the person simply deposits abnormally little fat in the subcutaneous tissues. The *asthenic* type has nothing in common with the type just described except the condition of under weight. Not only are these persons thin and apparently undernourished, but they are lacking in endurance and present a fairly characteristic bodily structure. They suffer from definite weakness, both physical and nervous. Many of them portray the "asthenic habitus," and in their attitude toward the world they often exhibit an inadequate personality. Lack of stamina is a salient characteristic; neither physically nor mentally are they able fully to meet the demands made on them. Their general musculature is poorly developed, and they often exhibit faulty development of the arterial system, with hypoplasia of the heart. The thorax is narrow and shallow. They have marked enteroptosis, and, as many of the invalids with gastrointestinal disorders belong in this class, they usually complain of all sorts of digestive disturbances. They are the victims of a vicious circle; because of poor development of the abdominal organs, both as to musculature and as to secretory function, they have poor digestion and are afraid to eat, which leads to greater weakness; and this in turn leads to still greater impairment of digestion.

These two types of leanness are as a rule distinct. Most thin persons show one or the other type, but borderline cases are occasionally encountered in which the leanness cannot fairly be assigned to either.

Treatment is unnecessary for persons with leanness of the *sthenic* type; true, some of them may occasionally benefit by being induced to eat a little more, but as a rule such advice is unnecessary. Patients showing the second type of leanness and those with the intermediary type can be benefitted greatly by diet and by other appropriate treatment.

*Endogenous leanness* accompanies a great variety of diseases, notably malignant growths, febrile diseases and other disorders which lead to tissue destruction and acceleration of metabolism. Relief of the underlying cause, if possible, should be the first consideration; thereafter dietary treatment is in order.

Included in this type is the leanness of endocrine origin, which, like the obesity of similar origin, is believed to be characterized by certain peculiarities of body configuration. Hyperthyroidism is the best known and most easily recognized disorder of this type. Less easily recognized is the thinness of pituitary origin; in one type there is a tendency toward gigantism, with a characteristic disappearance of the fat on the inner surface of the upper part of the thigh, but with no disturbance of sexual function. In another type there is the same overgrowth of the limbs, sometimes of the arms alone, with disappearance of the secondary sexual characteristics and hypoplasia of the genital organs. Another type is the hypophyseal cachexia of Simmonds, in which the skin is wrinkled, of a cachetic pallor and almost devoid of hair. Still another type, attributed to the adrenals, is characterized by emaciation with extensive hirsutism and increased libido. Lipodystrophia progressiva, with its characteristic skeleton-like face and with emaciation limited to the upper part of the body, is of unknown origin, but is believed to be related to disease of the endocrine organs. One must agree with Strang and Evans[15] when they comment on the paucity of criteria for proper identification of such endocrine disorders and emphasize the fact that undernutrition is sometimes a cause as well as an effect of endocrine imbalance.[16]

## Treatment of Leanness

**Principles of the Upbuilding Diet.** If a lean person can be induced to take sufficient food and can be prevented from burning this up too rapidly, he will gain weight. The truth of this statement was demonstrated by Strang and his associates[17] in their studies of patients undergoing dietary treatment for severe degrees of undernutrition. These investigators studied the basal metabolism, nitrogen metabolism and efficiency of digestion. They saw no changes in these factors which could themselves cause inanition, nor did they observe any new principle of metabolism which might mitigate the successful treatment of undernutrition by dietary measures.

In the arrangement of the diet there should be three chief considerations: (1) The patient's distaste or fear of food must sometimes be overcome. (2) The total caloric intake should be considerably in excess of the calculated maintenance intake. (3) The increase in body weight should include functioning protoplasm (muscle) as well as fat. accomplish the first of these it is often advisable to keep the

at least for the first two weeks, in a hospital If left to his own devices at home, even though he is given explicit directions, the asthenic patient will seldom take all the food prescribed, either he gets tired of eating, or he concludes that the food does not agree with him This psychic element, while a stumbling block at home, is as a rule easily overcome by the discipline of an institution The patient should not be told in advance what he is to eat At definite intervals the food in prescribed quantities should be brought to him, and he should be given to understand that he must eat all of it, to permit him to leave the least bit of food on his tray makes for poor morale In answer to his statement that he cannot take milk, that 'acid fruits' disagree with him or that meat is bad for him, he must be told bluntly that it is his duty to take what is set before him without question and that the physician will be responsible for results Unquestioning obedience must be demanded, and discipline should seldom be relaxed Soon the patient is aware that he begins to feel better and that, after all, the food has not hurt him Then, progress as a rule becomes easy and rapid

*Caloric Intake* The total caloric value of the diet should be from 50 to 75 per cent above that of the maintenance diet Great accuracy is not essential Roughly, from 3500 to 4000 Calories is appropriate for the average man or woman of ordinary height From their experience Strang and Evans[15] wrote

> Not all patients were able to ingest the full diet at once In special cases we have used diets of 2 200 to 2 500 calories for three to four days In practically all cases it was a simple matter to step up the intake of 3,500 calories after a week or two on a 3 000 calorie diet A 3,500 calorie diet produced an adequate rate of gain in the ordinary case Higher levels have been used on special cases the maximum for our series being 5 100 to 5 300 calories

*Protein Allowance* The protein quota should be ample It should be in the form of good proteins of high biologic value, such as those of meat, eggs and milk The authors just quoted saw good results with an intake of 50 to 70 gm of protein, but occasionally the allowance reached 90 to 100 gm It is advisable, as a rule, to give more, 100 to 120 gm

*Carbohydrate Quota* Carbohydrate should always furnish at least 50 per cent of the Calories and should be taken largely in the form of bread, cereals fruits and sugary foods While it is necessary, in order to provide as many Calories as possible, to include many concentrated foods one should not lose sight of the necessity for roughage Fat in rather large quantities is given because of its high caloric value it is best taken in the form of cream, butter and bacon The need for vitamins and minerals should be kept in mind To secure these the patient should be given a sufficient amount of milk, orange juice and tomatoes and always some leafy vegetable such as cabbage, broccoli, lettuce and spinach

*Rest* Rest and the cultivation of repose are both important When the patient is up and about, a rest of one or two hours in a room alone after the midday meal should always be advised, this is a valuable

conservation measure Likewise wasteful purposeless movements should as far as possible be eliminated in the furtherance of which mild sedatives are sometimes useful

*Exercise* As the treatment progresses in order to insure the development of muscle rather than the mere deposition of fat appropriate exercise should also be advised Walking is best swimming is good and golf for many reasons is excellent The chief desideratum is that the exercise be carried out regularly and according to some definite plan

*Results* Permanence of result should be an important object of treatment For this reason the person should not attempt to induce rapid gains in weight since he is more likely to experience normal development of muscle and other structures if his weight is gained gradually This should not be merely a fattening procedure it should be upbuilding and educational

*Milk in the Upbuilding Diet* Milk is the food on which greatest dependence should be placed It has two distinct advantages *(a)* its great food value both as to Calories and as to its component foodstuffs and *(b)* the relative ease with which large quantities can be taken even in the absence of appetite Because of its lack of flavor and its fluidity it is less objectionable to the patient with anorexia than other foods True patients sometimes object even to milk but the person who is cooperative can take milk when it is impossible for him to take other foods Many persons say that milk disagrees with them which usually means that they do not like it Unless he has a clear idiosyncrasy or unless there is a history of true anaphylaxis from milk proteins and this is rare the patient should take the milk as directed

For similar reasons eggs are valuable they can be given with the milk diet Cooked eggs are to be preferred but these sometimes have an objectionable flavor not found in fresh raw eggs Eggs which have beaten in milk flavored and sweetened are often prescribed This mixture has nutritive value and sometimes provides an agreeable variation in the diet but for the patient who has no appetite and is trying to take large quantities of food such mixtures are sometimes an abomination As a rule straight milk undisguised and eggs beaten with milk are better

For the milk diet there is a little trick which works well with the patient in the hospital Never tell him in advance what food he is to take for the first three days give him nothing but milk—a glass (250 cc) every two hours from 7 A M to 9 P M Unless the milk is of average richness a little cream should be added After three days without previous notice give him a tray containing a large attractive meal and tell him that he must eat all of it As a rule by this time his stomach and his psyche are ready for solid food and he will take it After this he should be given three large meals daily with interval feedings The subsequent diet is outlined at the end of this chapter

*Insulin* Insulin by increasing the patient s appetite is believed by some to be an effective aid in the upbuilding diet This has been demonstrated on rats by MacKay and his associates[18] They did not

find regular insulin effective, but reported that protamine zinc insulin in similar doses had a remarkable effect upon the appetite Insulin is said to be most useful with the psychoneurotic patient. Shepardson[19] cautiously increased the insulin given his seventeen patients until physiologic effects were seen, 20 to 64 units were administered daily, and achieved uniformly good results A like experience was reported by Nahum and Himwich,[20] who were able by this means to overcome nausea in a graphic manner Of a distinctly different tone, however, is the report of Freyberg [21] In a series of experiments designed to distinguish between purely psychic influences and the physiologic effects of insulin, this physician saw little of the true physiologic effect He attributed the good results reported by others to the influence of suggestion and concluded that insulin is of no value in the treatment of undernutrition My own experience inclines me to concur in this opinion

**Emaciation.** Emaciation in extreme forms was seen in Europe during World War I, and subsequent studies showed that the most effective treatment includes a diet high in protein and energy value This is discussed by Pollock,[22] who emphasizes the precautions to be observed in treatment and the value of protein therapy In extremely emaciated subjects weighing 50 to 75 pounds he warns against the danger to the heart of intravenous therapy of any type Fluids in excess of 1000 to 1500 cc, even when given by mouth, were not well tolerated These patients were able to utilize protein efficiently, and their ability to digest the intact protein was unimpaired Protein hydrolysates were not found to be practicable

Pollock found the milk and egg drinks listed in Table 81 most suitable The quantities given were suspended in water to make 1 liter, and sugar (usually 20 gm) with a little cocoa, vanilla or coffee extract was added

**Table 81 Composition of Three Dehydrate Milk and Egg Drinks** (Pollock[22])

| Ingredients | Calories | Protein (Gm) | Fat (Gm) | Carbohydrate (Gm) |
|---|---|---|---|---|
| Dried skim milk, 250 gm, dried egg 100 gm | 1450 | 136 | 43 | 130 |
| Dried whole milk, 250 gm, dried egg, 100 gm † | 1810 | 111 | 109 | 97 |
| Dried skim milk, 250 gm, dried egg white, 125 gm | 1299 | 184 | 3 5 | 130 |

* For flavoring purposes approximately 20 gm of sugar were usually added which added approximately 80 Calories to the mixtures not indicated in caloric calculations

† Nutrient content of the mixture calcium 3 3 gm, phosphorus 32 gm iron, 16 0 mg vitamin A, 5850 I U, thiamine, 1 1 mg, riboflavin, 3 4 mg, niacin 2.5 mg and ascorbic acid 17 mg

| Upbuilding Diet | Protein (Gm ) | Calories (Approximate) |
|---|---|---|
| I Sunday | | |
| Breakfast | | |
| 1 cup (½ pt ) of orange juice | | |
| 4 tablespoonfuls of Huskies ⅓ glass of cream 2 teaspoonfuls of sugar | 3 | |
| 2 egg jelly omelet 1 teaspoonful of butter | 12 | |
| 1 popover with 1 teaspoonful of butter | 3 | |
| 1 cup of cocoa | 9 | |
| 10 A M | | |
| 1 glass of milk (⅓ cream) | 7 | |
| | 34 | 1300 |
| Dinner | | |
| ½ glass of tomato juice | | |
| Average helping of roast lamb 1 tablespoonful of mint jelly | | |
| 2 tablespoonfuls of steamed rice roast broth | 3 | |
| Average helping of green peas 1 teaspoonful of butter | 6 | |
| 1 helping of lettuce 1 tablespoonful of Thousand Island Dressing | 1 | |
| 2 tablespoonfuls of chocolate ice cream | 5 | |
| 2 ladyfingers | 3 | |
| 1 glass of whole milk | 7 | |
| 4 P M | | |
| Fruit milk shake (½ glass of orange juice ½ glass of rich milk 1 egg Shake well add 2 teaspoonfuls of honey) | 10 | |
| | 35 | 1450 |
| Supper | | |
| 1 cup of cream of potato soup croutons | 7 | |
| 6 stalks of asparagus on toast 1 teaspoonful of butter | 4 | |
| Salad lettuce and 2 halves of peaches 1 tablespoonful of cream dressing | 1 | |
| Baked custard (individual) whipping cream | 10 | |
| 1 slice of toast 1 teaspoonful of butter | 3 | |
| 1 glass of milk (⅓ cream) | 8 | |
| Bedtime | | |
| 1 glass of milk 2 graham crackers | 9 | |
| | 42 | 1550 |
| Total | 111 | 4300 |
| II Monday | | |
| Breakfast | | |
| Average helping of honeydew melon or cantaloupe | 1 | |
| 1 Shredded Wheat biscuit | 3 | |
| ⅓ | 2 | |
| 1 | | |
| | 8 | |
| 2 | | |
| jelly | 6 | |
| 1 cup of cocoa or milk | 9 | |
| 10 A M | | |
| Milk shake (⅓ cup of cream 2 eggs 1 teaspoonful of sugar) | 19 | |
| | 48 | 1700 |

| | Protein (Gm) | Calories (Approximate) |
|---|---|---|
| *Dinner* | | |
| Small helping of roast chicken (white meat) | 32 | |
| 1 teaspoonful of jelly | | |
| 4 tablespoonfuls of creamed noodles | 2 | |
| *2 tablespoonfuls of green lima beans* | 3 5 | |
| Lettuce and tomato salad | 5 | |
| 1 tablespoonful of mayonnaise 1 tablespoonful of cottage cheese | | |
| 2 whole wheat raisin muffins 1 tablespoonful of butter | 6 | |
| 2 tablespoonfuls of *Spanish cream 2 tablespoonfuls of whipped* cream | 13 | |
| 1 glass of whole milk | 7 | |
| 4 P M | | |
| 1 cup of hot chocolate 2 tablespoonfuls of whipped cream 2 sugar cookies | 12 | |
| | 80 | 2300 |
| Supper | | |
| 6 creamed oysters on toast | 12 | |
| Medium sized baked potato 1 teaspoonful of butter | 4 | |
| Average helping of glazed carrots 1 teaspoonful of sugar | | |
| Lettuce salad with cheese dressing (½ tablespoonful of mayonnaise 1 tablespoonful of cream cheese) | 4 | |
| Raisin rice pudding 4 tablespoonfuls of cream | 7 | |
| 1 slice of whole wheat bread 1 glass of rich milk | 11 | |
| Bedtime | | |
| 1 glass of whole buttermilk 2 graham crackers | 8 | |
| | 46 | 1500 |
| Total | 174 | 5500 |
| III Tuesday | | |
| Breakfast | | |
| 4 prunes 1 sliced orange | 3 | |
| 4 tablespoonfuls of oatmeal 2 teaspoonfuls of sugar and 4 tablespoonfuls of cream | 8 | |
| 2 hot whole wheat biscuits 1 tablespoonful of butter 1 tablespoonful of marmalade | 6 | |
| 1 cup of cocoa with 1 tablespoonful of whipped cream | 9 | |
| 10 A M | | |
| Pep cocktail (1 egg yolk beaten into 1 glass of orange or grape fruit juice sweetened with honey) | 10 | |
| | 36 | 1006 |
| Dinner | | |
| 2 heaping tablespoonfuls of creamed chicken on toast | 16 | |
| 1 grilled sweet potato 1 teaspoonful of butter | 3 | |
| 2 heaping tablespoonfuls of green lima beans or 4 tablespoonfuls of green peas | 4 | |
| Salad tomato stuffed with cottage cheese 1 tablespoonful of mayonnaise | 5 | |
| 2 hot rolls 1 tablespoonful of butter | 6 | |
| 2 heaping tablespoonfuls of ice cream | 5 | |
| 1 glass of milk (⅓ cream) | 7 | |

| | Protein (Gm) | Calories (Approximate) |
|---|---|---|
| 4 P M | | |
| 1 glass of orange and grapefruit juice | | |
| | 46 | 1650 |
| Supper | | |
| Cheese dream (2 slices of bread 1 slice of American cheese toasted) | 16 | |
| 2 tablespoonfuls of hominy grits 2 teaspoonfuls of butter | 2 | |
| Cooked apple salad with 3 dates 1 tablespoonful of cream dressing | 1 | |
| 1 muffin with 8 teaspoonfuls of butter | 3 | |
| 2 tablespoonfuls of tapioca cream pudding | 6 | |
| 1 glass of iced cocoa with whipped cream | 9 | |
| Bedtime | | |
| Hot malted milk | 9 | |
| | 46 | 1800 |
| Total | 128 | 5050 |
| IV Wednesday | | |
| Breakfast | | |
| ½ large broiled grapefruit (1 tablespoonful of butter 2 tablespoonfuls of sugar browned in oven) | 2 | |
| 4 | | |
| | 5 | |
| St | 6 | |
| 2 graham muffins 1 tablespoonful of butter | 6 | |
| Cocoa with 1 tablespoonful of whipped cream | 9 | |
| 10 A M | | |
| 1 glass of rich milk 2 graham crackers | 9 | |
| | 37 | 1650 |
| Dinner | | |
| Egg and potato puff (1 egg beaten in with 2 heaping tablespoonfuls of mashed potatoes and 1 tablespoonful of butter browned [individual]) | 9 | |
| Baked tomato stuffed with rice and cheese | 9 | |
| | 8 | |
| | 3 | |
| | 6 | |
| 2 tablespoonfuls of whipped cream chocolate blanc mange | 6 | |
| 1 glass of whole milk | 7 | |
| 4 P M | | |
| 1 cup cocoa 1 tablespoonful of whipped cream 4 homemade cookies | 11 | |
| | 51 | 2050 |
| Supper | | |
| Cream of tomato soup 1 tablespoonful of whipped cream 4 crackers | 4 | |
| Small baked potato 1 teaspoonful of butter | 1 | |
| 6 panned oysters on toast | 8 | |
| 2 tender stalks of celery | | |
| Rice pudding 4 tablespoonfuls of cream | 8 | |
| 1 glass of rich milk | 7 | |

| | Protein (Gm) | Calories (Approximate) |
|---|---|---|
| **Bedtime** | | |
| 1 glass of milk 5 figs | 11 | |
| | 42 | 1550 |
| Total | 133 | 5250 |
| **V Thursday** | | |
| **Breakfast** | | |
| 1 glass of orange juice | | |
| 4 tablespoonfuls of farina 2 teaspoonfuls of sugar 4 tablespoonfuls of cream | 5 | |
| 2 slices of creamed toast with 1 egg yolk (egg à la goldenrod) | 7 | |
| 1 glass of rich milk | 7 | |
| *10 30 A M* | | |
| 1 glass of whole buttermilk with 2 oz of cream 2 graham crackers | 10 | |
| | 29 | 800 |
| **Dinner** | | |
| Broiled steak (tenderloin) | 23 | |
| 2 heaping tablespoonfuls of steamed rice butter or steak juice | 5 | |
| Creamed English peas | 6 | |
| Salad apple shredded carrot raisins 1 tablespoonful of cream dressing | 2 | |
| 2 whole wheat or white rolls 1 tablespoonful of butter | 6 | |
| 1 heaping tablespoonful of ice cream on small slice of chocolate cake | 5 | |
| 1 glass of rich milk | 7 | |
| 4 00 P M | | |
| 1 hot water ½ orange | 1 | |
| | 55 | 1850 |
| **Supper** | | |
| Jelly omelet (1½ eggs spread 1 tablespoonful of jelly then fold) | 10 | |
| Average helping of corn and tomatoes | 3 | |
| Average helping of lima beans | 7 | |
| Frozen fruit salad 2 slices of whole wheat bread butter | 9 | |
| 1 glass of rich milk | 7 | |
| **Bedtime** | | |
| 1 glass of hot malted milk | 10 | |
| | 46 | 1300 |
| Total | 130 | 3950 |
| **VI Friday** | | |
| **Breakfast** | | |
| 1 large baked apple with dates 2 tablespoonfuls of whipped cream | 4 | |
| 5 heaping tablespoonfuls of Puffed Rice with sugar ½ glass of thin cream | 4 | |
| 2 whole wheat biscuits with butter and 1½ tablespoonfuls of preserves | 6 | |
| Cocoa with 1 tablespoonful of whipped cream | 9 | |

| | Protein (Gm) | Calories (Approximate) |
|---|---|---|
| 10 30 A M | | |
| 1 large glass of egg lemonade | 7 | |
| | 30 | 1750 |
| Dinner | | |
| Broiled mackerel with lemon | 12 | |
| 1 medium sized baked potato | 4 | |
| Average helping of string beans | | |
| Salad medium sized tomato stuffed with celery and tomato pulp | | |
| 1 tablespoonful of mayonnaise | 2 | |
| 2 corn muffins with butter | | |
| Coffee Spanish cream apricot sauce with egg custard | 5 | |
| 1 glass of rich milk | 7 | |
| 4 00 P M | | |
| Chocolate egg milk | 15 | |
| | 45 | 1100 |
| Supper | | |
| Cream of pea or corn soup 4 crackers | 7 | |
| Scalloped oysters | 11 | |
| [illegible] | 9 | |
| [illegible] | 6 | |
| [illegible] | 7 | |
| [illegible] | 7 | |
| Bedtime | | |
| 1 dish of prunes 1 glass of rich milk | 8 | |
| | 55 | 1450 |
| Total | 130 | 4350 |

## Recipes for Upbuilding Diet

| | (Gm) | Protein (Gm) | Fat (Gm) | Carbohydrate (Gm) | Calories |
|---|---|---|---|---|---|
| Whole Wheat Raisin Muffins | | | | | |
| 1¼ cups whole wheat flour | 172 | 20 | 1 | 140 | 700 |
| ¼ teaspoonful salt | | | | | |
| 2½ teaspoonfuls baking powder | | | | | |
| 1 tablespoonful sugar | 15 | | | 15 | 60 |
| 1 egg | 50 | 6 | 6 | | 70 |
| 2 tablespoonfuls melted fat | 30 | | 30 | | 270 |
| 1⅓ cups milk | 320 | 10 | 13 | 16 | 225 |
| ½ cup seeded raisins | 60 | 2 | 2 | 46 | 210 |
| | 647 | 38 | 52 | 217 | 1,535 |
| Makes 12 large muffins each | 53 9 | 3 2 | 4 4 | 18 | 128 |

| Popovers | (Gm) | Protein (Gm) | Fat (Gm) | Carbohydrate (Gm) | Calorie |
|---|---|---|---|---|---|
| 1 cup flour | 128 | 14 | 1 | 95 | 450 |
| 1/4 teaspoonful salt | | | | | |
| 1 tablespoonful melted fat | 15 | | 15 | | 135 |
| 2 eggs well beaten | 100 | 12 | 12 | | 152 |
| 1 cup milk | 240 | 8 | 10 | 12 | 169 |
| | 483 | 34 | 38 | 107 | 906 |
| Makes 10 muffins each | 48 3 | 3 4 | 3 8 | 10 | 90 |

Mix into a smooth thin batter cook in hot greased muffin tins in hot oven for thirt minutes and at 350° F for fifteen minutes

Soft Custard
1/2 cup milk
1 egg yolk
1 heaping tablespoonful sugar
4 tablespoonfuls contains 131 Calories

Custard Pudding
2 cups milk
2 eggs
1/4 cup sugar
2 heaping tablespoonfuls contains 183 Calories

Rice Custard Pudding
1 cup boiled rice
2 eggs
1 1/2 cups milk
2 heaping tablespoonfuls sugar
2 heaping tablespoonfuls contains 179 Calories

Malted Milk
2/3 glass milk
1 heaping tablespoonful malted milk
Contains 221 Calories

Spanish Cream
1 heaping teaspoonful gelatin
2 heaping tablespoonfuls sugar
1 cup milk
1 egg
1 tablespoonful sherry
2 heaping tablespoonfuls contains 204 Calories

Chocolate Custard
1 heaping teaspoonful chocolate
1 heaping tablespoonful sugar
1 cup milk
1 egg
2 heaping tablespoonfuls contains 200 Calories

Tapioca Pudding
2 cups milk
1 egg
3 tablespoonfuls Minute Tapioca
2 tablespoonfuls sugar
3 heaping tablespoonfuls contains 172 Calories

Ice Cream
3 cups milk
1 cup cream
3 eggs
2/3 cup sugar
Vanilla
2 heaping tablespoonfuls contains 189 Calories

Cream Cheese on Toast
1 1/2 cups milk
2 heaping tablespoonfuls butter
2 heaping tablespoonfuls flour
} cream sauce
3 teaspoonfuls American cheese
3 tablespoonfuls cream sauce
Melt cheese in sauce and pour over 1 average sized slice of toast serve hot
Contains 200 Calories

Egg and Cheese Soufflé

1 egg

1 teaspoonful grated cheese — 1 teaspoonful butter for pan

Whip white and yolk separately and beat all together, season and bake in casserole in quick oven, serve at once

Contains 210 Calories

Apple and Celery or Waldorf Salad

1 average sized apple — 1 tablespoonful mayonnaise

3 small stalks celery — 3 English walnuts

Cut apple and celery in small pieces and mix with mayonnaise serve on lettuce leaf, chop walnut meats and sprinkle on top

Contains 349 Calories

Thousand Island Dressing

1 tablespoonful mayonnaise

Mixed with a bit of onion carrots, green peppers, tomato, etc

Contains 187 Calories

Potato Salad

1 medium sized boiled potato — 1 tablespoonful mayonnaise

Cut potato in small cubes mix with a bit of onion, green pepper and some pickles, chill and serve on lettuce

Contains 332 Calories

French Dressing

4 tablespoonfuls salad oil — 1/4 teaspoonful salt

1 tablespoonful vinegar — Pepper

2 teaspoonfuls contains 74 Calories

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# 18

## *Food Poisoning and Allergy*

### FOOD POISONING

Food poisoning is not only responsible for the occasional outbreak in epidemic form of well characterized illness but is believed also to be the cause of many mild digestive disorders Such poisoning when not due to an alkaloid of vegetable origin (mushrooms) a metallic poison or individual hypersensitiveness is the result of bacterial contamination

*Bacterial contamination* of food has become a serious public health problem This is emphasized in the excellent analysis of reported out breaks by Hussemann and Tanner [1] who state that the five organisms found to cause the greatest number of food poisonings were in decreas ing order respectively Staphylococcus Streptococcus (septic sore throat) Salmonella the Shigella and *Eberthella typhosa* The source of trouble is as a rule food which has not been kept or prepared with the requisite cleanliness such as the rice pudding cited by D Albora and his asso ciates [2] this was apparently contaminated by a chronic carrier and per mitted to stand at kitchen temperature for several hours The semisolid consistency of such foods is often responsible for the extent of the epidemic for this permits the poisonous material to permeate more readily the entire mass Typical in this respect are ground meat mix tures and cream puffs I have seen a violent epidemic of food poisoning due to cream puffs from the filling of which *Staphylococcus aureus* was cultivated

The symptoms of food poisoning which may appear at any time from two to thirty six hours after the offending material is eaten are nausea vomiting abdominal pain diarrhea and prostration These are of every grade of severity sometimes the vomiting is distressingly violent and the prostration profound The symptoms which accompany staphylococcal food poisoning are characterized in addition by their early onset and by the absence of fever The Salmonella infections produce a variety of disorders such as Salmonella fever septicemia and gastroenteritis [3] The usual sources of infection are human carriers es pecially food handlers insufficiently cooked pork or fowl and food which has been contaminated during storage [3a] The clinical manifestations seen in the 350 cases in one epidemic reported by D Albora and his associates included pronounced gastrointestinal upset severe prostration and

toxicity, high fever, herpes, bacteremia, neuritis and bronchopulmonary involvement with pneumonia A number of cases showed a postacute phase characterized by lowgrade fever, asthenia, fleeting aches and pains, and leukopenia with relative lymphocytosis Except when due to botulism, food poisoning usually subsides after a brief course, with complete recovery

The prevention of bacterial contamination can as a rule be accomplished by proper precautions regarding the handling of food, such as is now being insisted upon by boards of health and like agencies Among such precautions should be listed pasteurization of milk, cleanliness, the elimination of disease carriers among those who handle food, and the avoidance of food obtained from diseased animals

The treatment of the patient with food poisoning consists in ridding the intestinal tract of the offending material, which as a rule is effectively accomplished by spontaneous vomiting and diarrhea, and instituting supportive measures If dehydration threatens, physiologic solution of sodium chloride may be given subcutaneously or intravenously Polyvalent anti Salmonella serum is being tried in appropriate cases with inconclusive results The same is true of the use of sulfaguanidine and other sulfonamides Weiner and Liebler's report[3b] of a recent epidemic would indicate that chloramphenicol has a bacteriostatic though not curative effect Morphine may be necessary for the relief of abdominal pain

The *new insecticides,* through food contamination, may be a potential source of danger This has become the subject of intensive investigation[3c] The concern is not so much for acute poisoning as for the possible effects of the long continued ingestion of these materials Contamination may involve vegetables or fruits that have been treated directly or animal products from animals which have been exposed to some of these materials Information is accumulating rapidly on the proper place of these useful agents and the possibility of hazard, if any

Botulism Botulism is the most serious form of food poisoning the mortality is high It is true intoxication due to the eating of food in which *Clostridium botulinum* has been allowed to grow and produce a specific poison This organism is found in almost all soils, it grows abundantly under anaerobic conditions in foods which are improperly preserved Its poison develops in preserved and canned foods which have been inadequately sterilized and perhaps also in overripe or spoiled foods Commercial canning organizations have perfected methods for the destruction of these organisms, and since 1925 no instances have been reported of botulism due to food commercially canned *in the* United States[4] Epidemics have been reported, however, from the use of imported canned foods and from improperly home canned products

The *symptoms* of botulism are great prostration, difficulty in swallowing, dilatation of the pupils diplopia, rapid cardiac action accumulation of mucus in the throat, and eventual paralysis of the respiratory tract The mortality is 80 per cent or more, necropsy reveals extensive parenchymatous changes in all the inner organs

*Prevention* is simple Greater publicity should be given to the dangers

which lurk in home canned foods and appropriate legislation should be enacted The nonacid vegetables especially string beans corn and spinach are the most dangerous It is said that the addition of 10 per cent brine renders the cold pack method safe but Cruess an authority on home canning methods states that the only safe method is sterilization under pressure and that the various methods which use boiling water are unsafe and should not be used He insists for example that string beans in cans of size no $2\frac{1}{2}$ be subjected for thirty minutes to a sterilizing process at 240° F and corn for ninety minutes at the same temperature All home canned foods should be thoroughly boiled before they are eaten

*Treatment* is as a rule ineffective because irreparable damage has usually been done before the nature of the disease is recognized A homologous antitoxin given sufficiently early will neutralize the toxin and perhaps save the patient It should be tried in every case

**Trichinosis** Trichinosis results from eating raw or improperly cooked pork infested with *Trichinella spiralis* This small worm invades the muscle fibers and in the severer forms of trichinosis produces general myositis At first there is fever and generalized muscular tenderness which involves not only the muscles of the extremities but also those concerned with mastication speech and respiration Acute myocarditis is not uncommon as is evident from electrocardiographic changes seen in a large proportion of the cases [5] Particularly characteristic is edema of both the upper and the lower eyelids Conjunctival hemorrhages sometimes occur and occasionally scarlet rashes of brief duration appear These changes are believed to be due to an increased permeability of the vascular tree notably the capillary wall [5b] There is usually marked leukocytosis and the characteristic eosinophil count is 50 per cent or more The patient may become extremely debilitated and anemic After a few weeks the worm becomes encysted and the symptoms largely disappear This description applies to severe trichinosis The disease is often so mild as to escape recognition altogether [6] in such a form it may even reach epidemic proportions

Trichinosis is much more common in America than is ordinarily believed Riley and Scheifley[7] report from Minnesota that an examination of 117 cadavers of subjects who had never exhibited any evidences of trichinosis revealed an incidence of 17 9 per cent of trichinous infection They also quote the report of Queen who in 7 5 per cent of 344 consecutive necropsies made in Rochester noted evidence of trichinosis Hall and Collins[8] state that in forty one of 300 patients from Washington and Baltimore who had died of causes other than trichinosis the diaphragm was infested with the trichinella Similar reports have come from other sources and the feeling is general today that trichinosis is a fairly frequent and as a rule unrecognized disease

The *diagnosis* is not difficult The edema of the eyelids the intense headache and the pain on flexing or extending the neck are all significant The most important and characteristic laboratory finding is the eosinophilia which according to Kaufman [9] may reach an astounding figure of 50 per cent or higher eosinophilia however is not always

present Bachman s intracutaneous test gives a positive reaction about two weeks after the invasion The antigen (0 1 cc) is injected intra dermally on the inner side of the forearm and a like amount of the solvent (Coca s solution) is injected in the same manner and in the same location on the opposite side In trichinosis a reaction appears within ten or fifteen minutes The test gives a positive reaction in about 90 per cent of proved cases It is said to remain positive as long as three years When there is doubt the muscle biopsy should be done

To escape trichinosis one needs merely to avoid uncooked sausage and to eat only such pork as has been thoroughly cooked The prevalent assumption that government inspected meat is always free from trichi nellae is an error no microscopic examination for trichinellae is made by the government inspectors In calling attention to the gravity of the trichinosis problem in the United States Gould[10] advises that all pork be processed by government order He believes that the time will come when the public will insist that the pork it eats no less than the milk it drinks is safe for human consumption

Rest in bed mild purgation and a simple nourishing diet are recom mended for the patient with an acute attack of trichinosis

**Mushroom Poisoning** From the earliest times mushrooms have been regarded as a delicacy Certain varieties however are poisonous more than eighty species being found in America The most poisonous mushrooms belong to the genus Amanita two species of which account for almost all the poisoning Both are extremely common in all parts of this country *Amanita phalloides* causes over 90 per cent of the deaths and *Amanita muscaria* is responsible for most of the remaining fatalities due to mushroom poisoning

Mushroom poisoning according to Vander Veer and Farley[11] can be divided into two types the rapid and the delayed In the rapid type for which the fungi of the *Amanita muscaria* group are responsible symptoms are produced within one to three hours after ingestion of the food Profuse salivation lacrimation sweating severe abdominal pains nausea and vomiting are characteristic symptoms The pupils are small there is great prostration and convulsions and coma may super vene Patients with this type of poisoning respond well to treatment and the mortality is low

The other type of mycetismus produced by fungi of the *Amanita phalloides* group is distinguished by its slow onset The first symptoms appear from six to fifteen hours after the fungi are eaten Prominent among these are extreme nausea and vomiting with severe abdominal pains and diarrhea In addition there are evidences of damage to the central nervous system the kidneys and the liver Hepatic injury is manifested as a rule by jaundice The mortality is 50 per cent or higher

The pathologic changes which occur in mycetismus have been thor oughly studied by Vander Veer and Farley[11] who report widespread damage to the central nervous system In this are included not only congestion and edema but also degenerative changes in the brain cells Equally significant are the degenerative changes in the parenchyma of the liver and to a less extent in the tubular epithelium of the kidneys

The *treatment* of mycetismus depends somewhat upon the type whether rapid or slow The authors just quoted believe that the early vomiting and purgation which occur in the rapid type rid the body quickly of a large part of the poisonous material and for this reason they advise that no attempt be made to correct these symptoms If the stomach has not been completely emptied gastric lavage should be performed or an emetic given A saline purge also is advisable Atropine sulfate which may be given in doses as large as 1/25 grain (2 6 mg) and repeated after a few minutes is of value in counteracting the effect of the muscarine Caffeine and epinephrine are also to be given when prostration is great After the intestinal tract has been thoroughly emptied morphine should be administered for relief of the abdominal pain and the delirium

In the delayed type of mycetismus the poisonous material has greater opportunity for absorption and so is more likely to be fatal Every effort should be made to clear the intestinal tract the patient should be thoroughly purged and the lower portion of the bowel irrigated Absolute rest in bed which should be continued until complete recovery is evident is essential Relapses have occurred when patients have been permitted to get up too soon

The diet should be liquid and because of the hepatic damage should be low in fat and high in protein and carbohydrate Fluids should be forced and dextrose solution given intravenously

### ALLERGY

The term allergy has many and varied connotations According to Opie[12] this term should be limited to the changed state in relation to antigens that follows their introduction into the body This includes both the tissue changes localized at the site of contact with the antigen and the acute functional disturbances such as anaphylactic shock which follow dissemination of the antigen by way of the blood stream These changes are produced supposedly by the release of histamine (or possibly of heparin or choline) when the antigen comes in contact with the antibody The cardinal symptoms of anaphylaxis can thus be explained as being due in the immediate instance to an autointoxication by physiologically active substances normally resident in various tissue cells and liberated therefrom by some change in cellular permeability brought about by the antigen antibody reaction [13]

An example of such a reaction is seen in the violent localized inflammation leading even to necrosis which a sensitized animal exhibits after the introduction of an irritant which under other circumstances would produce little or no inflammation This localized reaction which occurs when the antigen comes in contact with the antibody is the allergic inflammation its area is limited and the antigen is permitted to go no farther Crystalline egg albumin for example injected into the skin of a normal rabbit spreads widely and quickly gains entrance to the circulation but produces little or no reaction If it is injected into an allergic animal it produces a violent inflammation and remains localized This localization is not true however of anaphylactic shock

which is vastly more extended in its influence The latter is manifested by a profound general disturbance which occurs in a sensitized animal when the antigen gains access to the general circulation and meets the antibody To prevent this the allergic inflammation fixes the antigen at the site of its penetration into the tissues and by forestalling its entrance into the blood stream protects the internal organs from the injury of anaphylactic shock[12] Thus allergic inflammation may be regarded as a mechanism of defense against the invasion of bacteria and other foreign substances

Success in counteracting the physiologic effects of histamine and thus the penalties of allergy has been achieved to some extent by the use of the recently devised antihistaminic drugs notably benadryl and pyribenzamine These should be used however with due caution because they have many untoward effects Waldbott[14] lists the efficacy of these drugs as follows

| | Per Cent of Efficacy* |
|---|---|
| Urticaria | 85 to 95 |
| Hay fever | 70 to 80 |
| Vasomotor rhinitis | 60 to 70 |
| Asthma Oral | 40 to 50 |
| Asthma Intravenous | 65 to 75 |
| Pruritus of eczema and contact dermatitis | 30 to 40 |
| Migraine | 25 to 35 |
| Gastrointestinal allergy | Doubtful |

* Based on own data those of Dr Carl Arbesman Buffalo and the review of Dr S M Feinberg

The part which allergy plays in immunity or in the production of allergic disease does not come within the scope of this discussion The chief interest here is in the frequency with which persons become allergic to food and in the foods which most often produce this state Enthusiasts have attributed a vast array of disorders to food sensitization but many of their claims have little substance A well balanced view of the question is taken by Alvarez and Hinshaw in their paper dealing with the foods that disagree with certain persons (see p 141) While they take the precaution to emphasize the fact that all food sensitiveness is not allergic in nature they believe nonetheless that allergy is a fairly frequent cause of digestive distress as well as of migraine and other disorders

Any food can in theory call forth allergic manifestations Unfortunately the commoner foods are most often at fault The authors just quoted as well as many allergists claim that wheat milk, eggs cabbage tomatoes oranges and chocolate are the greatest offenders wheat ranking first These foods should be given first consideration in the effort to solve clinical problems of allergy but no food should be regarded as innocent until so proved

Many factors are apparently of influence Heredity seems to play an important role in the production of allergy but the inheritance is seldom specific more often it has its origin in an underlying instability which may lead in almost any direction Rackemann[15] expresses it well

in his statement that persons who have allergic constitutions have the capacity for the development of sensitiveness Vitamin deficiency has been claimed to play a role in the development of allergic states, but the evidence is not convincing

The variability of such sensitiveness has been the subject of frequent comment The allergic person may on a certain day experience a reaction to a given food and on another day eat the same food with impunity Sometimes the general physical status is a determining factor, and an allergic response may occur only when the subject is fatigued or emotionally upset Allergy with its multitudinous variations is one of the most elusive of clinical problems

The diagnosis of allergy is based on the information obtained from the history, from certain cutaneous and laboratory tests and by means of elimination tests From a skillfully taken history it is often discovered that the allergic attack follows the eating of some particular article of food. Sometimes it is advisable to have the patient record with great fidelity and in detail over a given period both the food that he eats and any disturbances which might be attributed to allergy

*Cutaneous tests* are of some value, but great caution should be exercised in their interpretation Rackemann and Simon noted positive reactions to the intradermal test in 50 per cent of normal persons, and Grow and Herman[16] reported essentially the same experience This lack of dependability of the test is believed to be explainable in part by variations in sensitiveness Nervous emotional and other physiologic states may exert a determining influence This subject was well summarized by the editor[17] who wrote A few qualified allergists of wide clinical and technical experience make and read skin tests with judicious restraint and thus properly utilize a diagnostic procedure of unquestionable value However, the indiscriminate use of skin tests for the solution of puzzling clinical problems is apt to lead physician and patient far afield

*Provocative diets* are regarded by Lee and Squier[19] as of great value in the recognition of food allergy Unless earlier observations contraindicate, wheat, milk, egg, beef, orange and potato are eaten as the only food for approximately a week These constitute a good diet and are also the foods most often responsible for allergy Sensitivity to any of these foods will probably become evident before the trial period is up If not then other foods can be added to the test diet If exacerbations occur with this provocative diet, then further observation and trial is essential

The *elimination diet* is believed also to be of genuine diagnostic value When as frequently happens neither the history nor the cutaneous tests clear up the diagnosis resort must be had to this procedure The elimination diets devised by Rowe[18] are given in Table 82 and menus Diets 1 and 2 may be used separately or together If sensitization to cereals, as a group is suspected, then diet 3 should be used in the beginning Absolute adherence to the prescribed diets is imperative else they are valueless Rowe s suggestions regarding their use are embodied in the following rules

1 Diets 1 and 2 may be used together or separately substitutions of similar foods may be made for foods known to produce reactions

2 Diet 3 should be used initially if sensitization to cereals as a group is suspected

3 The selected diet should be continued at least ten days possibly three or four weeks since the reacting bodies sometimes disappear slowly If relief is not obtained another elimination diet should be tried

4 Absolute adherence to the prescribed diet and meticulous care in its preparation are essential Dishes prepared in restaurants may be deceptive Commercial breads cookies and soups are not permitted

5 Nutritive failure should be guarded against The prescribed fruits and vegetables provide vitamins A B C and $B_2$ but when these appear insufficient vitamins bought at the drug store may be taken When milk is excluded meat should be taken twice daily as well as calcium glutonate 15 grains (1 gm) twice daily If there is loss of weight *the permissible amount of sugar starch or fat should be increased*

6 When a lengthening in the periods of relief is obtained other foods taken from the other elimination diets may be cautiously added Thereafter vegetables fruits meats spices and nuts are gradually added After one to three months wheat milk and egg may separately be added with careful observation of results If an allergic response to any food is manifested this article must again be eliminated Such response according to the patient s tolerance may appear immediately or even several days or weeks after the article has been added to the menu

Table 82 Elimination Diets

| Diet 1 | Diet 2 | Diet 3 | Diet 4 |
|---|---|---|---|
| Rice | Corn | Tapioca | Milk* |
| Tapioca | Rye | White and sweet potato | |
| Rice biscuit | Corn pone | Lima bean potato bread | |
| Rice bread | Corn rye muffin | Soya bean lima bean bread | |
| | Rye bread | | |
| | Rye crisp | | |
| Lettuce | Tomato | Beets | |
| Spinach | Squash | Carrots | |
| Carrot | Asparagus | Lima beans | |
| Beet | Peas | String beans | |
| Artichoke | String beans | Tomato | |
| Lamb | Chicken | Beef | |
| | Bacon | Bacon | |
| Lemon | Pineapple | Lemon | |
| Grapefruit | Peaches | Grapefruit | |
| Pears | Apricot | Peaches | |
| | Prunes | Apricot | |
| Cane sugar | Cane sugar | Cane sugar | |
| Wesson Oil | Mazola Oil | Olive oil | |
| Olive oil | Wesson Oil | Wesson Oil | |
| Salt | Salt | Gelatin | |
| Gelatin | Karo Corn Syrup | Salt | |
| Syrup made of maple sugar or cane sugar flavored with mapleline or maple sugar | Gelatin | Olives | |
| *Olives* | | Maple syrup or syrup made with cane sugar flavored with maple | |
| Pear butter | | | |

(From Rowe A H Clinical Allergy Philadelphia Lea and Febiger)

Note Wesson (cottonseed) Oil is included in all diets With allergy to cottonseed as shown by skin test or history this must be excluded and a cottonseed oil shortening such as Crisco must not be used If allergy to cane sugar is suspected beet sugar or corn glucose may be used

* Milk should be taken up to two or three quarts a day Tapioca cooked with milk and milk sugar also may be taken

**Suggested Menus for Elimination Diets (Rowe)**

| Diets 1 and 2 | Breakfast | Approximate Amounts |
|---|---|---|
| Beverage | (a) Grapefruit (fresh) juice or lemonade with sugar as desired<br>(b) Pineapple juice | 1 glassful |
| Cereal | (a) Boiled brown or polished rice or cooked corn meal served with apricot peach or prune juice and sugar<br>(b) Rice Krispies or corn flakes served with grape fruit juice and sugar or with apricot peach or prune juice or maple syrup<br>(c) Cold rice or corn meal fried in Mazola Oil or bacon or chicken fat served with maple syrup or Karo Corn Syrup | ½ cup rice<br>3 teaspoonfuls juice or<br>¾ cup dry flakes |
| Meat | (a) Bacon (moderately crisp) or<br>(b) Lamb chops lamb or chicken croquettes<br>(c) Lamb kidney or liver fried with bacon | 3 slices or<br>1 medium chop |
| Bread | (a) Corn pone<br>(b) Corn rice muffin<br>(c) Corn rye muffin<br>(d) Rice biscuit<br>(e) Rice bread<br>(f) Rye bread<br>(g) Ry Krisp | 2 muffins or 2 slices toasted |
| Jams or preserves | (a) Peach or prune jam<br>(b) Apricot or apricot pineapple jam or preserves<br>(c) Grapefruit and lemon marmalade<br>(d) Pear butter | 2 tablespoonfuls |
| Fruit | Sliced or whole grapefruit canned fresh or stewed peaches apricots pears pineapple or prunes | |

NOTE Choices as indicated by letters are offered in all menus though more than one may be used if desired Chicken meat and fat should come only from broilers or roosters Hens frequently have egg on them as a result of breaking unlaid eggs in dressing them Breads muffins and cookies should be made at home or by bakers who follow the recipes given in these diets Rye flour especially is apt to be mixed with wheat and commercial rye bread practically always contains wheat and milk Corn meal can be obtained in different degrees of fineness

This menu contains approximately 612 Calories

| | | | |
|---|---|---|---|
| Grams of carbohydrate | 92 | Grams of calcium | 0 104 |
| Grams of protein | 16 | Grams of phosphorus | 0 200 |
| Grams of fat | 20 | Grams of iron | 0 0027 |

| Diets 1 and 2 | Lunch and Dinner | |
|---|---|---|
| Salad | (a) Lettuce with apricot peach pear or pineapple with oil dressing and lemon or juice or special mayonnaise<br>(b) Vegetable salad made of tomato carrots beets, asparagus peas string beans or artichokes with oil dressing or special mayonnaise<br>(c) Sliced tomato or lettuce—tomato with oil dressing<br>(d) Lemon gelatin with grated carrots and crushed pineapple | 2 halves or slices<br>½ cup mixed vegetables<br>1 tablespoonful oil or dressing |

| | | Approximate Amounts |
|---|---|---|
| Soup | (a) Lamb broth clear or with rice carrot peas string beans as desired | 1 cup |
| | (b) Chicken broth clear or with rice carrot peas string beans as desired | |
| | (c) Split pea soup | |
| Meat | (a) Lamb served as chops roast tongue or stew with lamb rice corn carrots peas beets or string beans | 2 medium chops or |
| | (b) Chicken—roasted fried broiled stewed may be rubbed with bacon if desired or stuffed with rice or corn meal | 1 broiler or equivalent |

NOTE. Thicken gravy or sauces with *rice flour or cornstarch*

| | | |
|---|---|---|
| Vegetables | Spinach carrots squash asparagus peas artichokes beets tomatoes | 4 tablespoonfuls vegetables |
| Bread | Choice of those in breakfast | |
| Jams or preserves | Choice of those in breakfast | |
| Dessert | (a) Fruit as suggested for breakfast | 4 tablespoonfuls fruit |
| | (b) Rice fruit pudding | 1 cup cake |
| | (c) Tapioca fruit pudding | |
| | (d) Corn rice cookies or rice cup cakes | |
| Beverage | (a) Grapefruit juice or lemonade with sugar Corn dextrose may be used if extra carbohydrates are desired | 1 glassful |

NOTE It is best to use canned preserved or fresh cooked fruits Uncooked fruits other than grapefruit or lemon are more apt to produce allergic reactions than heated fruits Dried fruits well cooked with the exception of prunes are not well tolerated by certain patients Soups may be made only with ingredients in the prescribed diets Canned soups and those in restaurants and hotels are apt to have wheat egg or other forbidden ingredients Meats must not be cooked or basted with any food such as wheat flour butter or spices not allowed Gravies must be thickened only with prescribed flours Gelatin may be incorporated in salads and desserts if desired

Salted Crisco and yellow Vaseline are accepted by some as butter substitutes

This menu contains approximately 864 Calories Total per day 2340 Calories

| | | | |
|---|---|---|---|
| Grams of carbohydrate | 125 | Grams of calcium | 0 211 |
| Grams of protein | 28 | Grams of phosphorus | 0 547 |
| Grams of fat | 28 | Grams of iron | 0 0091 |

Diet 1 Breakfast

| | | |
|---|---|---|
| Beverage | (a) Grapefruit juice or lemonade with sugar as desired | 1 glassful |
| | (b) Pear juice flavored with lemon | 1 glassful |
| Cereal | (a) Boiled or steamed brown or polished rice served with pear juice or maple syrup and sugar | 1½ cup cooked rice<br>3 tablespoonfuls syrup<br>¾ cup Rice Krispies |
| | (b) Rice flakes or Rice Krispies served with pears or pear juice and sugar | 4 tablespoonfuls juice<br>1 tablespoonful dry |
| | (c) Tapioca cooked in water and flavored with lemon juice lemon rind and sugar | tapioca for one serving |
| Meat | Lamb chops or liver patties | 2 medium chops |

| | | Approximate Amounts |
|---|---|---|
| Bread | (a) Rice biscuits<br>(b) Rice bread | 2 biscuits |
| Jam or preserves | (a) Pear butter<br>(b) Lemon or grapefruit marmalade | 2 tablespoonfuls |
| Fruit | (a) Sectioned or whole grapefruit<br>(b) Fresh or canned pears | 1 grapefruit<br>3 halves |

Note Corn sensitive patients might react to corn oil or glucose which must be excluded even in minute amounts

This menu contains approximately 768 Calories

| | | | |
|---|---|---|---|
| Grams of carbohydrate | 118 | Grams of calcium | 0 089 |
| Grams of protein | 29 | Grams of phosphorus | 0 400 |
| Grams of fat | 20 | Grams of iron | 0 0046 |

Diet 1 Lunch and Dinner

| | | Approximate Amounts |
|---|---|---|
| Salad | (a) Hearts of lettuce dressing of olive or Wesson oil and white vinegar<br>(b) Vegetable salad of lettuce carrots beets artichoke and olives as desired with above dressing or special mayonnaise<br>(c) Lettuce with sectioned grapefruit or pears served with oil and lemon juice dressing | ½ medium head<br>1 tablespoonful oil<br>1 cupful mixed vegetables<br>½ grapefruit or 2 halves of pears |
| Soup | Lamb broth clear or with tapioca or rice and carrots as desired | 1 cupful |
| Meat | (a) Lamb served as chops roast tongue<br>(b) Stew made with lamb rice or tapioca carrots or beets Thicken gravy with rice flour | 2 medium lean chops or their equivalent |
| Vegetables | Steamed or boiled rice brown or polished<br>Spinach carrots beets or artichokes | ½ cup cooked<br>4 tablespoonfuls |
| Bread | Choice of those suggested for breakfast | |
| Jam or preserves | Choice of those suggested for breakfast | |
| Dessert | (a) Plain lemon or lime gelatin with pears or grapefruit as desired<br>(b) Winter pears baked with maple syrup or brown sugar<br>(c) Rice cookies or cup cakes<br>(d) Puffed rice candy<br>(e) Tapioca fruit pudding<br>(f) Rice fruit pudding | <br>1 large pear<br>1 cup cake |
| Beverage | Choice of those suggested for breakfast | 1 glassful |

Note Pure olive oil and Wesson Oil only can be used in Diet 1 Imported oil may be adulterated Wesson Oil and Crisco must be excluded in the presence of positive reactions or of clinical allergy to cottonseed

This menu contains approximately 914 Calories Total calories for day 2596

| | | | |
|---|---|---|---|
| Grams of carbohydrate | 129 | Grams of calcium | 0 249 |
| Grams of protein | 32 | Grams of phosphorus | 0 557 |
| Grams of fat | 30 | Grams of iron | 0 0100 |

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# 19

## *Diseases of the Kidney and Urinary Tract*

### BRIGHT'S DISEASE

**Classification** The classification of Bright's disease adopted by Volhard and Fahr correlates in a satisfactory manner the clinical manifestations and the pathologic changes That devised by Addis, who approached the problem from a different angle, is similar The former classification recognizes glomerular nephritis, nephrosis and nephrosclerosis, the latter, hemorrhagic, degenerative and arteriosclerotic Bright's disease The terminology is different, but the diseases described are essentially the same (1) *Glomerulonephritis* (hemorrhagic nephritis) is characterized anatomically by an inflammatory destruction of the glomeruli and clinically by hematuria, gross or microscopic, cylindruria, hypertension and nitrogen retention, its onset is sudden, and its course may be acute, intermittent or chronic (2) *Nephrosis* (degenerative Bright's disease) is characterized anatomically by degenerative changes in the glomeruli and tubules and clinically by marked edema, hyaline casts and albuminuria, without hypertension or hematuria This disease is not to be confused with "lipoid nephrosis" (3) *Nephrosclerosis* (arteriosclerotic Bright's disease) is characterized anatomically by progressive thickening of the small renal arteries and clinically by marked hypertension, which later is accompanied by moderate proteinuria with hyaline casts and other evidences of renal disease There are two types, the mild, which is as a rule insidious in its onset and chronic in its course, and the severe (malignant hypertension), which may pursue an extremely stormy course In recent years increasing recognition has been given another form of kidney disease, *pyelonephritis* This is an inflammation of the kidney and renal pelvis The disease is chronic and results in the destruction of renal tissue with subsequent healing, fibrosis and contraction

**Metabolism of Bright's Disease** The basal metabolic rate is not altered in nephritis except when it is increased by dyspnea or decreased by edema The patient s nutritive needs, however, may be materially increased because of the losses of food water and chlorides which occur during vomiting because of the losses of protein in the urine and because of the muscular twitching and restlessness of uremia

The utilization of protein in nephritis does not differ from that in health except that in nephritis the need is greater because losses

results should be examined in the light of what constitutes a normal diet *for the rat and for man* It must not be too readily assumed that because excessive proportions of protein are harmful, normal proportions will also prove to be so"

The other aspect of this question, the need for protein, has had considerable light thrown upon it by the clinical observations of recent years A significant example of this need is seen in the low protein content of the plasma in Bright's disease and the unfavorable prognostic significance given it by Van Slyke and his associates This deficit must be made good, and the fact should be emphasized, as is evident from the work of Keutmann and McCann,[11] that proteins used for this purpose or for deposition in the tissues make no demands upon the excretory functions and cannot in this way injure the nephrotic patient As an indication of the benefits to be achieved by a fairly liberal intake of protein, as well as evidence of previous depletion of tissue proteins, Keutmann and Bassett[1] reported that when the caloric and protein contents of the diet were sufficient, all their patients stored large amounts of protein, this, with the maximal synthesis of protein was accomplished by an intake of this foodstuff well within normal limits Apparently this is not all that is accomplished by protein feeding, for Farr[12] reports that increases in the intake of protein of four children under four years of age with the nephrotic syndrome markedly influenced in like direction the urea clearance Intakes of 0 5, 1, 2 3 and 4 gm of protein per kilogram daily were accompanied by average urea clearances of 73, 88, 178, 184 and 216 per cent, respectively, of the mean normal Since the simultaneous administration of urea did not have a like effect upon the clearance, he concluded that the stimulus of renal function by high protein diets was due to products other than urea The evidence indicates that the patient with nephritis can with benefit utilize reasonably liberal amounts of protein

This benefit is seen in the testimony of Aldrich and Boyle,[13] who after observing 300 children with nephritis, wrote

> All the patients with chronic nonspecific nephritis were receiving a low protein diet and many were forced to eliminate salt as well Almost all were clinically ill and obviously dying off in spite of our good intentions [Then] all preconceived ideas of diet were discarded and we decided to treat these children exactly as we would any other group in as poor a nutritional state Meat or eggs were ordered three times daily salt was allowed to all those who were not definitely edematous and all the vitamins we had ever heard of were included in their diet

The authors thereupon saw marked general clinical improvement within a short time, and later they reported as a result of two years' experience with this dietary and hygienic regimen that the majority of their patients showed definite clinical improvement, with a decided reduction in the death rate McCann,[14] likewise, reported significant improvement in a group of nephritic patients after the allowance of protein was materially increased

The precise amount of protein necessary in a given case is determined by many clinicians by adding to the amount of protein which would be required normally the amount lost in the urine Mosenthal[15] states that for the average adult 75 gm of protein daily plus the amount

lost in the urine is proper Unless the proteinuria is extremely heavy, this means an intake of about 100 gm of protein daily When the proteinuria is heavy and the plasma protein deficit marked, as in the degenerative type of Bright s disease it may be necessary in order to promote storage to prescribe even larger amounts 125 gm or more In his patients with lipoid nephrosis Epstein reported remarkable im provement when they were given 120 to 240 gm of protein daily In nephrosclerosis this need for protein is not so urgent but nonetheless it should receive consideration

The *salt content of the diet* is deserving of consideration but the facts that the edema of nephritis is due largely to plasma protein deficit and that when sodium chloride is concerned it is the sodium rather than the chlorine ion which causes the trouble have robbed salt of some of its importance While restriction of salt up to a certain point is good in cases of edema such restriction should not be carried too far A series of observations which I made a number of years ago revealed that a salt free diet containing less than 0 5 mg of sodium chloride daily if long continued sometimes resulted in weakness and other evi dences of physical impairment [16] Similar observations were subsequently made by Landis and his associates [17] who reported that acute restriction of the intake of sodium chloride produced hypochloremia with char acteristic symptoms and temporary retention of urea creatinine and phosphates Renewed administration of sodium chloride relieved these symptoms A somewhat different opinion is expressed by Barker and Robinson [18] who wrote of the advantages of a low sodium high potassium acid ash diet in selected cases of chronic glomerular nephritis with edema but in the discussion of their paper Addis appropriately comments upon the dangers of applying this principle widely and using it in all cases In fact nothing could be more dangerous than such a diet for patients who are approaching the uremic level I think it proper to say that in all forms of nephritis the intake of salt should be restricted to a reasonable degree When edema is present salt should be limited to that contained in the natural food No salt should be used in the preparation of the food and none added after it comes to *the table this permits the equivalent of about 2 gm of sodium chloride* daily

The *base forming or acid forming qualities of the diet* have been re garded as of great importance by a few physicians notably Sansum and his associates who suggested that an acid forming diet by rendering the work of the kidney more difficult may impair still further its efficiency and may perceptibly increase the acidosis of impending uremia They advised that in addition to the usual precautions the diet be made predominantly basic and state that on such a diet patients afflicted with arterial hypertension and chronic interstitial nephritis appear to improve as evidenced by a fall in blood pressure a reduction in urinary casts and albumin and other symptoms referable to this combination of diseases in 90 per cent of the cases On page 385 will be found tables useful in arranging diets according to base forming qualities

The *water allowance* is deserving of consideration in Bright's disease in part because nephritis is accompanied by profound disturbances in the balance both of electrolytes and of water[4] and in part because water is possibly the most important single factor in the prevention of acidosis. During the marked oliguria of the acute stage nothing can be gained from a large intake of water. The intake should be restricted to accord somewhat with the output, but this restriction should not be continued long, for a great deal of fluid which must be replaced is lost through the bowels, skin and lungs. Restriction of the total fluid intake below 1 liter is seldom necessary. As the volume of urine increases the allowance of fluid may be increased, but there is no reason why it should ever exceed 2 liters a day. In the other stages and forms of Bright's disease extremes of water intake in either direction should be avoided.

## GLOMERULAR OR HEMORRHAGIC NEPHRITIS

Glomerular nephritis is an inflammatory disease of the kidneys which affects chiefly the glomeruli. It is distinguished by an acute onset, proteinuria, hematuria of variable degree, edema, hypertension, and as a rule nitrogen retention. Its course is variable. In addition to the acute and terminal stages there are also a latent and an active chronic stage. One of the hazards of the disease is that as the acute phase subsides the disease may go into a latent stage which, because of the paucity of symptoms, may remain unrecognized for years, only later passing into an active chronic or terminal stage. Of 205 patients observed by Murphy and Peters[19] over periods of two to ten years 43.5 per cent still showed, in latent or chronic form, evidence of the disease.

The *cause* of this disease, which often follows scarlet fever or tonsillitis, is bacterial invasion, usually by the Streptococcus. The frequency with which the Streptococcus is the cause of glomerulonephritis was first revealed in the observations of Longcope and his associates[20] and later was confirmed by the studies of Winkenwerder and his associates.[21] The latter investigators demonstrated that the source of the renal involvement is in the majority of instances an infection of the upper respiratory passages with the beta type of streptococci. Similar conclusions were reached by Seegal and his associates,[22] who found that the histories of a large group of patients revealed the preponderating dependence of glomerular nephritis upon a preceding streptococcal infection. In contrast to pyemic streptococcal renal disease, however, the organism is not found in the kidney. Apparently the active agent is a circulating streptococcal exotoxin.

Glomerular nephritis is essentially a disease of youth. In the last mentioned studies 50 per cent of the patients were under ten years of age and 70 per cent were under twenty years.

The *pathologic changes* in this disease occur chiefly in the glomeruli and, according to MacCallum, can be described as intercapillary rather than intracapillary. The workers at the Rockefeller Institute found that practically all the glomeruli were destroyed in every case in which

autopsy was performed. In those cases in which hypertension and cardiac enlargement had been salient features, marked arteriolar changes also were present

The *dietary treatment* in the acute stage of this disease, because of its relatively brief duration, does not demand the careful consideration necessary in the chronic disease In cases of severe involvement accompanied by nausea and vomiting it is regarded as good practice to withhold all food for one or perhaps two days,[22a] but recent animal experiments by Persike[22b] would indicate that starvation immediately following renal injury is accompanied by a much more rapid increase in blood urea leading perhaps toward uremia, than occurs when carbohydrate is given Lemonade and fruit juices may be allowed, and dextrose solution may be given intravenously or by rectum If, however, there is anuria or marked oliguria, the fluids should for a short time be limited to small quantities

A little later, or immediately in cases of moderate severity, the patient should be put on an all milk diet The milk should be of average richness and from 1½ to 2 pints should be given daily As other articles are added, the amount of milk may gradually be reduced to two or perhaps three glasses daily After one or two days of this diet, it is usually permissible to add cereals with cream (twice daily) and five or six slices of bread or toast with preserves and unsalted butter Fruit juices in liberal amounts and fresh fruits as well as cooked fruits, such as baked apple or stewed prunes may also be allowed

After the first week or ten days the effort should be to approximate the patient s caloric needs A nephritic patient weighing 150 pounds should while in bed receive from 1500 to 1700 Calories The intake of protein should approximate 30 to 50 gm daily, a little more than is provided by a quart of milk No salt should be used in the preparation of the food and none added after it comes to the table such a diet carries the equivalent of about 2 gm of salt

After the first month if the patient continues to improve, the protein quota can be increased, first to 60, then to 70 or perhaps even to 80 gm daily The caloric needs of a child judged by weight, are proportionately less but the protein needs of the older child approximate those of the adult

The fluids taken during this earlier period should be limited at first to 1000 or 1200 cc daily and sometimes especially if there is vomiting with edema to an even smaller amount As the output increases it is safe also gradually to increase the intake of fluids, and later it may as a rule be gradually increased to 1500 to 2000 cc If the patient is purged or is treated by sweating and if much fluid is lost through the skin appropriate amounts should be added to the intake Enough fluid to relieve thirst is necessary In computations of water balance it should not be forgotten that the so called dry foods provide some water and that all foodstuffs on metabolism yield appreciable amounts of water

In their efforts to remove the edema and to restore the normal concentration of serum protein in the nephrotic syndrome of chronic glomerulonephritis Smalley and Binger[23] advise either a salt free diet

or one containing only the salt used in preparation of the food and limit the intake of fluids to not more than 1 to 1½ quarts daily They increase the protein content of the diet to between 75 and 125 gm daily Because of its diuretic qualities potassium nitrate in doses of 3 gm three times daily is given indefinitely

The following menus are suitable for an adult during the second and third weeks of acute glomerulonephritis Thereafter, if he improves, both the caloric intake and the protein allowance must be increased These menus are also suitable in the more advanced active chronic stages of this disease For children, the amounts must be reduced proportionately

**Table 83 Menus for Patients with Glomerulonephritis (Second and Third Weeks)**

A minimum of salt to be used in the preparation of the food and no salt to be added after the food comes to the table

I Protein 55 gm Calories 1850

Breakfast
- 1
- 2
- 4
- 2 slices of toast and 1 teaspoonful of butter
- 1 cup of coffee 2 teaspoonfuls of sugar 1 tablespoonful of heavy cream

Dinner
- ⅔ glass of tomato juice
- 2 heaping tablespoonfuls of mashed potatoes with
- 2 *poached eggs*
- Average helping of beet or spinach greens
- Average helping of lettuce and tomato salad with nephritic dressing and 1 egg yolk
- 1 corn muffin 1 teaspoonful of butter
- 2 halves of canned peaches 1 tablespoonful of whipped cream
- ½ glass of milk

Supper
- *6 panned oysters 1 teaspoonful of butter*
- Medium sized baked tomato stuffed with 1 tablespoonful of corn 1 teaspoonful of butter tomato pulp
- 3 heaping tablespoonfuls of creamed celery
- Large salad ¼ grapefruit 1 orange 12 grapes *1 tablespoonful of cream dressing*
- 1 slice toast
- ½ glass lemonade 1 tablespoonful of lemon juice 1 teaspoonful of sugar

*II Protein 55 gm Calories 1700*

Breakfast
- ½ glass of orange juice
- 5 tablespoonfuls of corn flakes ¼ cup of milk
- 1 thin slice of crisp bacon on
- 1 small slice of creamed toast (1 tablespoonful of cream sauce)
- 1 cup of coffee 1 teaspoonful of sugar 1 tablespoonful of thin cream

*Dinner*
- ¼ glass of tomato juice
- Small baked potato 1 teaspoonful of butter
- Creamed codfish (3 tablespoonfuls of cream sauce)
- *Average helping of steamed cabbage butter*
- Salad ¼ small head of lettuce 1 teaspoonful of French dressing 3 stalks of celery 1 tablespoonful of cottage cheese
- 1 corn muffin
- Large grapefruit and orange cup
- ½ glass of milk

Supper

Average helping (4 oz) of pea soup 2 crackers
1 slice of cold tongue small pickle
½ cup of noodles 1 teaspoonful of butter
2 heaping tablespoonfuls of mashed turnips
Salad 1 large tomato cucumber lettuce lemon juice
1 slice of bread 1 teaspoonful of butter
2 heaping tablespoonfuls of Snow pudding

III Protein 60 gm Calories 1750

Breakfast

1 fresh peach or 2 slices of pineapple
2 heaping tablespoonfuls of oatmeal 1 teaspoonful of sugar and
2 tablespoonfuls of thin cream
2 poached eggs on toast
1 cup of coffee 2 teaspoonfuls of sugar 1 tablespoonful of thin cream

Dinner

3 heaping tablespoonfuls of baked spaghetti and tomato

½ glass of milk

Supper

2 heaping tablespoonfuls of hominy grits 1 teaspoonful of butter
3 tablespoonfuls of carrots
3 tablespoonfuls of green peas
Salad 2 halves of pears on lettuce nephritic dressing
1 bran muffin
Snow pudding made with saccharin (individual)
½ glass of buttermilk

Bedtime

½ glass of orange juice

IV Protein 70 gm Calories 1850

Breakfast

1
3
1
2 thin slices of crisp bacon
1 piece zwieback 1 teaspoonful of butter
1 cup of coffee

Dinner

Average helping of roast beef (medium fat)
⅔ glass of tomato juice
2 heaping tablespoonfuls of mashed potatoes with ½ tablespoonful of cheese grated and heated

1 slice of whole wheat bread 1 teaspoonful of butter
3 heaping tablespoonfuls of Floating Island pudding

Supper
- ½ cup cream of corn soup
- Average helping of asparagus on ¼ slice of toast
- ½ cup of green lima beans
- ¼ head let uce 1 tablespoonful of Thousand Island dressing
- 4 l eaping tablespoonfuls of fresh berries
- ¼ slice of toast
- ½ glass of milk

V Protein 60 gm Calories 1850

Breakfast
- ½ cup of fresh berries or pear
- 2 heaping tablespoonfuls of farina 2 teaspoonfuls sugar and
- 4 tablespoonfuls of coffee cream
- 2 eggs scrambled in 1 tablespoonful of cream
- 1 toasted roll 1 teaspoonful of butter
- 1 cup of coffee 1 teaspoonful of sugar 1 tablespoonful of cream

Dinner
- Fruit cup
- 1 slice (1 oz) of boiled ham
- 1 tablespoonful of mashed potato or baked squash
- 2 heaping tablespoonfuls of string beans
- Generous helping of coleslaw tomatoes and cucumber 2 teaspoonfuls of French dressing (equal parts of lemon juice and oil)
- 1 corn muffin 1 teaspoonful of butter
- Average slice of sponge cake 1 heaping tablespoonful of ice cream

S ipper
- Average helping of cream of celery soup 2 Uneeda crackers
- ½ cup of boiled noodles mushroom sauce (⅓ cup of chopped mushrooms 2 table spoonfuls of white sauce)
- Average helping of spinach egg yolk
- Salad tomato stuffed with celery cucumber and tomato pulp 2 teaspoonfuls of mayonnaise
- 1 whole wheat ra sin muffin
- Snow p idding made with saccharin and 1 egg white

The following menus are suitable for adults during the latent stage of *glomerulonephritis* If the losses of protein in the urine are heavy more protein should be added in the form of two or more eggs or perhaps of an additional helping of meat

**Table 84 Menus Suitable after Third Week of Glomerulonephritis**

I Protein 75 gm Calories 2700

Breakfast
- 1 large baked apple stuffed with 10 raisins
- 1 Shredded Wheat biscuit 2 teaspoonfuls of sugar ⅓ cup of whole milk
- 1 scrambled egg in tomato 1 teaspoonful of butter
- 1 raisin muffin 2 teaspoonfuls of butter
- 1 cup of coffee 2 teaspoonfuls of sugar 2 tablespoonfuls of coffee cream

10 30 A M
- 1 medium sized orange

Dinner

(no fat)
of butter

1 glass buttermilk

4 00 P M
- Medium sized bunch (about 1/4 lb) of grapes

Supper
- Average helping of cream of pea soup 2 saltines
- 2 tablespoonfuls of mashed potatoes or rice
- 2 teaspoonfuls of butter
- 2 heaping tablespoonfuls of new string beans (cut lengthways)
- Salad 1/4 cup of cut beets 1/2 hard boiled egg mixed with 1/2 tablespoonful of mayonnaise lettuce
- 1 small slice of bread
- 1/2 glass of milk
- 1 heaping tablespoonful of orange ice

II Protein 80 gm Calories 2600

Breakfast
- 1/2 large grapefruit
- 2 heaping tablespoonfuls of farina with
- 4 tablespoonfuls of 2% cream 2 teaspoonfuls of sugar
- 2 slices of creamed toast with
- 1 1/2 thin slices of crisp bacon
- 1 cup of coffee cream and sugar

10 30 A M
- 1/2 glass of grape juice

Dinner
- 1/2 cup of grapefruit pulp
- 1/2 slice of roast hen (white meat)
- 2 tablespoonfuls of steamed rice with juice from roast
- 2 heaping tablespoonfuls of green lima beans
- Salad tomato stuffed with celery tomato pulp 1 tablespoonful of cream cheese 1 tablespoonful of mayonnaise
- 1 French roll 1 teaspoonful of butter
- 2 heaping tablespoonfuls of apple tapioca pudding 1 tablespoonful of whipped cream
- 1/2 glass of milk

4 00 P M
- 1/2 glass of fruit juice

Supper
- [illegible]
- Average helping of creamed carrots and celery
- Salad 1/4 small avocado 1/2 canned peach 1/2 canned pear 2 teaspoonfuls of French dressing
- 1 slice of whole wheat bread 1 teaspoonful of butter
- 1 glass of milk

III Protein 80 gm Calories 2700

Breakfast
- 2/3 glass of orange juice
- 3 heaping tablespoonfuls of Grape Nuts 1/3 cup whole milk 2 teaspoonfuls of sugar
- 1 medium sized broiled tomato 1 teaspoonful of butter
- 2 whole wheat raisin muffins 2 teaspoonfuls of butter
- 1 cup coffee sugar and cream

10 30 A M
- 1 glass of lemonade (2 teaspoonfuls of lemon juice 2 heaping teaspoonfuls of sugar)

Dinner

- ⅔ glass of tomato juice
- ½ cup of creamed fish on 2 heaping tablespoonfuls of mashed potatoes, garnished with parsley
- Average helping of steamed cabbage, 1 teaspoonful of butter
- Salad ¼ small avocado, ½ average sized cucumber, few slices of onion, 1 table

4 00 P M

- 1 small bunch of Concord grapes

Supper

- 1 egg fluffy omelet, fold in 1 tablespoonful of jelly, butter
- 2 heaping tablespoonfuls of whole hominy
- Baked asparagus (½ cup of cut asparagus, ¼ cup of milk, crumbs of 2 slices of bread 2 teaspoonfuls of butter, seasoning)
- Sliced tomato and cottage cheese salad, ½ tablespoonful of mayonnaise
- 2 popovers, 1 teaspoonful of butter
- ½ cup of grapefruit pulp
- ½ glass of milk

IV Protein, 85 gm , Calories 2800

Breakfast

- 1 cup of strawberries or 1 orange, sliced
- 4 heaping tablespoonfuls of barley cooked with milk, served with
- 1 teaspoonful of sugar, 4 tablespoonfuls of coffee cream
- 1 slice of French toast, 1 tablespoonful of jelly or jam
- 1 cup of coffee, sugar and cream

10 30 A M

- ½ glass of berry juice

Dinner

- Average helping of roast lamb mint sauce
- Medium sized baked potato, juice of roast
- Spinach with 1 egg yolk
- 2 heaping tablespoonfuls of buttered beets
- Waldorf salad ½ apple 1 English walnut, 1 tablespoonful of mayonnaise, 2 small stalks of celery
- 1 slice of bread or 1 biscuit, 1 teaspoonful of butter
- 3 heaping tablespoonfuls of tapioca pudding, fruit sauce
- ½ glass of orange juice

Supper

- Average helping of homemade chicken soup
- 4 mushrooms on ½ slice of toast
- Baked tomato stuffed with corn and tomato pulp, 1 teaspoonful of butter
- Salad ½ large grapefruit, 2 teaspoonfuls of French dressing
- 1 roll, 1 teaspoonful of butter
- 1 glass of milk

V Protein, 90 gm , Calories, 2700

Breakfast

- ½ cantaloupe or 1 medium sized orange
- Baked egg (grease custard cup with ½ teaspoonful of butter, break 1 egg into cup and pour over 1 tablespoonful of milk)
- 2 thin strips of crisp bacon
- 2 popovers with 1 teaspoonful of butter
- 1 cup of coffee, 2 teaspoonfuls of sugar, 2 tablespoons of coffee cream

10 30 A M

1 medium sized raw apple grated if desired

Dinner

⅔ glass of tomato juice
1 lean beef patty (4 inches) with large broiled mushrooms
2 heaping tablespoonfuls of spaghetti and tomatoes
Cauliflower en casserole with 1 inch cube of cheese (individual)
¼ head of lettuce 1 tablespoonful of Thousand Island dressing
1 slice of whole wheat bread 1 teaspoonful of butter
Orange custard pulp of 1 medium sized orange ¼ cup of soft custard
1 glass of milk

4 00 P M

¾ glass of grape juice

Supper

6 large panned oysters on toast
½ medium sized baked stuffed potato 1 teaspoonful of cheese 1 teaspoonful of butter
Average helping of green peas
Spinach salad served with ½ hard boiled egg and lemon on nest of lettuce
1 whole wheat raisin muffin 1 teaspoonful of butter
1 glass of orange juice

## DEGENERATIVE BRIGHT'S DISEASE (NEPHROSIS)

Nephrosis was the name originally coined by Friedrich von Muller and subsequently adopted by Volhard and Fahr to indicate that the origin of this disease is other than inflammatory To avoid confusion with another clinical concept, Addis used the term "degenerative Bright s disease' This disease is insidious in its onset, it is characterized by heavy proteinuria and a tendency toward edema, which is sometimes excessive A plasma protein deficit is also a salient feature, so much so that Peters and his associates[4] reported it to be the only consistent and characteristic finding in their studies They regard it as the sole abnormality which can definitely be related to the presence or absence of edema The course of the disease also is variable It may subside completely or it may progress downward, with or without an intervening latent stage, to a fatal termination

Van Slyke and his associates state that degenerative Bright's disease may be distinguished clinically from glomerulonephritis by the fact that the former lacks four of the salient features of the latter hematuria retention of urea, hypertension and anemia They add, however, that in their series, hypertension and hematuria were the only features which were uniformly absent

The *cause* of this form of Bright s disease may be any of a numerous group of infections and intoxications, among which are tuberculosis, syphilis, osteomyelitis, and toxemia of pregnancy An occasional case is encountered which cannot be related to any pre existing illness or intoxication and must be regarded as of unknown origin

Pathologically, the disease is characterized by degenerative changes in the renal glomeruli and tubules The heart and blood vessels remain intact

The *dietary regulation* of degenerative Bright's disease has as its

object not merely the protection of the kidney, but primarily the replacement of the protein lost in the urine and the compensatory deposition of protein in the tissues This requires much the same type of diet that has been recommended for the second and subsequent weeks of glomerulonephritis except that the allowance of protein should as a rule be more liberal and the intake of salt perhaps more restricted A regimen of this type was devised by Keith and his co workers[94] at the Mayo Clinic, who emphasized the necessity for control of both the water content and the mineral quota of the food They found that the foods provided in their routine salt poor diets contained too much water, from 1200 to 1400 cc, since this amount when added to that taken as fluid brought the actual daily intake of fluids up to 1800 to 2400 cc In constructing their diet the effort was (1) to decrease the water contained, (2) to reduce the amount of sodium and (3) to control the diet so that this minimal content of water would for practical purposes be the same from day to day

During the first two or three weeks the patient is given a diet sufficient to meet his basal metabolic requirements that is, one providing *1500 to 1800 Calories and 50 to 60 gm of protein* In their original paper these clinicians emphasized the advisability of selecting foods low in both water and mineral content, but the necessity for this is perhaps open to question The patient should take 600 gm of fruits and vegetables, of which at least 400 gm should be in the form of fresh fruits and green vegetables Oranges, grapefruit, bananas, lettuce, tomatoes and string beans are suitable Canned tomatoes and canned string beans of any standard brand may be used The fluid permitted by the authors just quoted amounted to a liter or a little less, but this may be too low Certainly during the summer months and in warm climates larger amounts are needed A little later, in the third or fourth week of the disease, the caloric value of the diet should be increased to keep pace with the patient's increased activities The protein quota should be increased to 80 or 100 gm daily, more if the losses in the urine are great No salt should be added to the food after it comes to the table For a short time edematous patients may be given food prepared without salt

**Table 85 Menus of Liberal Protein Content Suitable in Degenerative Bright's Disease**

I Protein 150 gm Calories 2100

Breakfast

- ½ medium sized grapefruit
- 2 heaping tablespoonfuls of farina 1 teaspoonful of butter
- 3 oz of minced chicken giblets
- 1 popover
- 1 cup of coffee with 1 teaspoonful of sugar

Dinner

- *⅓ glass of tomato juice*
- 2 [illegible]
- 2 [illegible]
- 2 [illegible]
- *Salad ½ apple* [illegible] e mineral oil mayonnaise
- 1 slice of whole wheat bread
- Individual baked custard (½ cup of milk 1 egg yolk 1 teaspoonful of sugar)

Supper

1 cup homemade chicken soup
12 panned oysters on toast, 1 teaspoonful of butter
1 large broiled tomato
2 heaping tablespoonfuls each of turnip cubes and green peas
¼ head of lettuce, ½ tablespoonful of French dressing
1 slice of bread
*Spanish cream (no 1)*
½ glass of buttermilk

II Protein 165 gm, Calories, 2150

Breakfast

½ slice of toast 1 inch cube cheese
1 cup of coffee 1 teaspoonful of sugar

Dinner

Oyster cocktail (6 oysters)
Average helping of roast chicken (no fat)
1 heaping tablespoonful of steamed rice with juice of chicken
Beet or turnip greens with egg yolk
Salad ½ grapefruit, ½ orange lettuce mineral oil mayonnaise
Snow pudding
1 corn muffin

Supper

1 cup of mock turtle soup 2 Uneeda crackers
Average helping of sweetbreads, tomato sauce
Average helping of squash
1 heaping tablespoonful of mashed potato
*Spinach salad 1 egg yolk 1 slice of lemon, lettuce*
3 heaping tablespoonfuls of Floating Island
1 small raisin muffin

III Protein, 150 gm, Calories 2100

Breakfast

1
5
1
1 popover
1 cup of coffee or tea with 1 teaspoonful of sugar

Dinner

½ cup grapefruit pulp
Large helping of white meat of turkey with
½ dozen broiled oysters
3 tablespoonfuls of green peas
1 large tomato stuffed with tomato pulp and celery mineral oil mayonnaise, seasoning
Apple whip made with
1 small baked apple 2 egg whites 2 teaspoonfuls of sugar
1 slice of whole wheat bread

Supper

1 small cup (6 oz) of homemade chicken soup
Average helping of tenderloin steak mushroom sauce (2 large mushrooms chopped and broiled in steak juice)
1 tablespoonful of steamed rice
2 tablespoonfuls of green lima beans
3 small stalks of celery
Beet and egg salad with mineral oil mayonnaise on lettuce
2 heaping tablespoonfuls of prune soufflé
1 piece zwieback

**LIPOID NEPHROSIS**

This is regarded by a few investigators as a clearly defined disease entity of uncertain nature It is believed to represent, not a disease of the kidney, but rather a general metabolic disturbance, as is indicated in Epstein's designation 'diabetes albuminuricus" or Munk's 'physio chemical modification of body colloids' The similarity of its symptoms to those of protein starvation is striking, Barker and Kirk, working in Christian's clinic, were able by greatly reducing the protein level of the blood to produce in dogs all the signs of this disease

The distinguishing clinical features of lipoid nephrosis are said to be edema, marked albuminuria, oliguria, a decrease in the total protein content of the blood, with a relative increase in the globulin content, and the presence of doubly refractile lipoid droplets in the urine In addition, it is distinguished by the absence of the usual signs of nephritis such as hematuria, nitrogen retention, impaired urinary out put of phthalein and vascular hypertension

The propriety of regarding lipoid nephrosis as a disease *sui generis* rather than as a symptom complex which may occur in many forms of subacute or chronic nephritis is open to question Coleman[25] believes that although the lipoid syndrome may exist independently as in lipoid nephrosis, it occurs most often in chronic glomerular nephritis The disease is rare and is difficult of recognition When in the course of apparent lipoid nephrosis, hematuria and other symptoms of actual nephritis appear, as a rule the designation is changed to glomerular nephritis One clinician writes Only the eventual course of the dis ease can determine the diagnosis," while others state that in the course of years nephrosis may pass into genuine contraction of the kidney An excellent critique has been offered by Christian,[26] who regards the condition as merely a form of chronic nephritis McCann quotes the observations of Blackman that the anatomic data in cases of classic lipoid nephrosis studied by him proved that the condition was in truth diffuse glomerulonephritis Opposed to this, however, is the view of Van Slyke and his associates [27] who state that when the clinical observations also are taken into consideration, there can be no doubt of the diagnosis in genuine lipoid nephrosis

However great the differences of opinion as to its true nature, this type of nephropathy is accompanied by a protein deficit of such extent that its dietary treatment warrants special consideration In the face of such a deficit a liberal ration of protein is essential, but some question has been raised as to the necessity for giving the extremely high protein diets originally advised Liu and Chu[28] found in their two cases that the optimal diet was one which contained 1 8 to 2 5 gm of protein per kilogram of body weight They reported that amounts in excess of this were not retained Major[29] also found that excessive amounts of pro tein were not stored, but were excreted as urinary nitrogen One wonders therefore, whether the large amounts of protein prescribed by Epstein[30] are necessary

Attempts have been made to compensate for the plasma protein def icit and consequent loss of colloidal osmotic pressure encountered in

this disease and in degenerative Bright's disease by the intravenous injection of solution of acacia Contrary to the experience of others Johnson and Newman[31] observed no serious complications from the intravenous injections of acacia They report that when followed by the injection of mercurial diuretic this treatment proved a valuable aid in eliminating nephrotic edema in adults Nonetheless it would seem that since the use of concentrated solutions of serum protein has been introduced a foreign colloid such as acacia is entirely unnecessary Excellent results have been reported from the use of concentrated human blood serum in nephrosis

The *diet* prescribed by Epstein in lipoid nephrosis is as follows

| | |
|---|---|
| Food value | 1280 to 2500 Calories |
| Protein | 120 to 240 gm |
| Fat (unavoidable) | 20 to 40 gm |
| Carbohydrate | 150 to 300 gm |

The following articles of food are used lean veal lean ham white of egg oysters gelatin lima beans lentils split peas green peas mushrooms rice oatmeal bananas skim milk coffee tea and cocoa

Coleman[25] advises that the sodium intake be restricted to less than 0 5 gm daily and that water be given freely

## NEPHROSCLEROSIS

Nephrosclerosis is a vascular disease which in its later stages is accompanied by impairment of the kidneys True the arterial hypertension which precedes all evidence of renal disease is apparently due to a pressor substance produced by the kidneys as was first indicated by Goldblatt and his associates[32] but before there is recognizable disease of the kidneys there is sclerosis of the arterioles The latter presumably gives rise to the nephrosclerosis Two forms of the disease are recognized the benign and the malignant

The *symptoms* of the relatively benign type of nephrosclerosis are meager until the disease is well advanced The salient clinical features at first are arterial hypertension cardiac hypertrophy and slight proteinuria with fixation of the specific gravity There is no hematuria Later vague digestive disorders headaches and other disturbances are complained of as the disease becomes still more advanced the heart becomes greatly enlarged and symptoms of myocardial incompetency less often of renal failure dominate the picture Retention of nitrogen and retinal changes are late manifestations This is a disease of years and decades and death comes as a rule from circulatory incompetency rather than renal failure

Malignant nephrosclerosis or malignant hypertension was assumed by Volhard and Fahr to represent the addition of glomerular inflammation to a pre existing nephrosclerosis but MacMahon and Pratt[33] concluded that both clinical and pathologic considerations warrant the recognition of this as a separate and distinct disease McCann[34] in discussing the description given by MacMahon and his associates of the cardiovascular and renal lesions found in cases of basilophilic adenoma of the pituitary, recognizes a close resemblance between these lesions

and those of the malignant nephrosclerosis described by Fahr He expresses the growing conviction that this disease is a definite nosologic entity distinct from benign hypertension and closely related to eclampsia of pregnancy and to basophilia of the pituitary body

The *diet* in nephrosclerosis should be balanced and not unduly restricted The caloric intake should be reasonably small but nonetheless sufficient to meet the patient s needs Roughly the patient of sedentary habits can usually get along on 2000 Calories daily If he plays nine holes of golf twice weekly or takes a short walk daily he should be allowed 2500 Calories His requirements are approximately those of the normal man for a more complete discussion of which the reader is referred to Chapter 11 A gain or loss in weight is an excellent criterion of the adequacy of the diet The obese patient should be encouraged to lose weight gradually at the rate of 3 to 5 pounds each month until the ideal is reached Such reduction in weight not only conserves metabolism but lessens the burden of the heart The thin person s weight and vigor should be carefully maintained by an appropriately liberal diet

The allowance of protein should be sufficient not only to meet the patient s minimal needs but also to maintain him in the highest degree of strength and vigor for the greatest number of years The severe restriction of protein imposed in the past upon the patient with nephrosclerosis did I believe a great deal of harm it seriously limited his sense of well being and efficiency and perhaps even curtailed his life expectancy In cases of mild nephrosclerosis with little or no impairment of renal function a daily intake of 75 to 100 gm of protein is proper and in cases of moderately severe involvement an intake of 50 to 60 gm is adequate This permits in mild nephrosclerosis three glasses of milk daily two eggs and one average helping of meat and in moderately advanced nephrosclerosis three glasses of milk and one egg daily and an average helping of meat or fish three times weekly In the case of gravest involvement the blood urea content being high and signs of impending disaster being manifest the daily intake of protein should be limited to 25 or 35 gm *There is no difference as far as the patient is concerned between red and white meat and gram for gram the nephritic patient can take roast beef with the same impunity as he can take breast of chicken*[35]

In the further arrangement of the diet a wide latitude of choice should be permitted Carbohydrate should furnish more than half the total calories A part of the fat should be in the form of butter and cream Milk should always be included An abundance of vegetables and fruits should be taken both because of the vitamins they contain and because of their mineral content and base forming properties All condiments and alcoholic beverages should be absolutely interdicted The amount of tea and coffee should be reduced to the minimum (one cup daily) Fried foods and pastries unless especially well prepared should be forbidden this applies also to complex dishes such as croquettes and to all peppery piquant foods In order to place the least possible burden on the digestive organs and to assure the maximum of assimilation the food should be simple and easily digested

Salt should be permitted within reasonable limits Rigid restriction may do harm For patients who are accustomed to add large quantities of salt to their food it may be advisable to direct that no salt be added after the food comes to the table and that no unusually salty food be eaten The diet then will provide about 3 gm of sodium chloride daily, which is sufficient If the patient complains that such a diet is unpalatable, the addition of onion or other foods with distinctive flavor will sometimes lend a little zest Seasoning is a matter of taste, however, and it is not difficult for one to become accustomed to reasonably small quantities of salt

*Exercise* should also be considered in its relation to diet Youthful patients who lead a sedentary life should take more exercise of the right kind (golf and walking) Those who are accustomed to violent exercise should curtail their activity Too much exercise is hurtful Patients of middle age and older had best limit their exercise to golf and walking enjoyed leisurely and in extreme moderation It is appropriate here to quote a famous septuagenarian who to an inquiry replied that he obtained his exercise by acting as pallbearer at the funerals of his friends who had exercised!

**Table 86 Menus Suitable in Mild Nephrosclerosis**

I Protein 75 gm Calories 2000

Breakfast

1 average sized pear or sliced orange
2 heaping tablespoonfuls of corn flakes 2 teaspoonfuls of sugar ¼ glass of milk
1 soft scrambled egg 1 tablespoonful (¼ inch square) of grated cheese
1 bran muffin 1 teaspoonful of butter
1 cup of coffee or tea 2 teaspoonfuls of sugar 2 tablespoonfuls of coffee cream

Dinner

Average helping of roast lamb 1 teaspoonful of jelly
½
2
Sa
1
2

Supper

Small serving of creamed sweetbreads (3 tablespoonfuls of cream sauce ½ slice of toast)
1 small baked potato
2 be

II Protein 75 gm Calories 2000

Breakfast

½
2
1
1 slice of toast 1 teaspoonful of butter
1 cup of coffee or tea 1 teaspoonful of sugar, 1 tablespoonful of coffee cream

Dinner

1 patty (4 inches) of scraped beef (broiled)
2 heaping tablespoonfuls of spaghetti and tomato
2 heaping tablespoonfuls of squash
¼ cup of stewed tomatoes
Salad average helping of coleslaw cucumbers celery onion 2 teaspoonfuls of nephritic dressing
1 corn muffin with 1 teaspoonful of butter
Apple whip (1 medium sized baked apple 2 teaspoonfuls sugar 1 egg white)

Supper

10 panned oysters on 1 slice of toast 1 teaspoonful of butter
1 heaping tablespoonful of hominy with 1 teaspoonful of butter
2 heaping tablespoonfuls of string beans
Beet and egg salad with mineral oil mayonnaise
1 roll 1 teaspoonful of butter
Baked banana with 1 teaspoonful of sugar and lemon juice

### Menu Suitable in Advanced Nephrosclerosis

Protein 60 gm Calories 1800

Breakfast

½ cantaloupe or small orange
2 heaping tablespoonfuls of farina 1 teaspoonful of sugar 2 tablespoonfuls of thin cream
1 soft boiled egg
1 slice of toast 1 teaspoonful of butter
1 cup of coffee or tea 2 teaspoonfuls of sugar 1 tablespoonful of cream

Dinner

1 average helping of chicken fricassee
1 tablespoonful of mashed potatoes 1 teaspoonful of butter
2 tablespoonfuls of green peas
Average helping of carrots and celery 1 teaspoonful of butter
Salad tomato stuffed with vegetables on lettuce 1 tablespoonful of nephritic dressing
1 homemade biscuit 1 teaspoonful of butter
Fruit cup 2 slices of pineapple ½ cup of strawberries

Supper

1 scrambled egg served with 1 medium sized broiled tomato 2 teaspoonfuls of butter
Average helping of parsnips
½ small baked acorn squash or 4 tablespoonfuls of mashed squash 1 teaspoonful of butter
Salad 2 halves of peaches ½ tablespoonful of cream dressing or whipped cream
1 slice of bread or plain muffin 2 teaspoonfuls of butter
1 serving of Snow pudding

## PYELONEPHRITIS

Chronic pyelonephritis has been shown by Longcope[36] and Butler[37] and others to be a disease of grave potentialities An example of its gravity is seen in the report of Zimmerman and Peters [38] who told of the frequency with which pre existing pyelitis or pyelonephritis is the cause of toxemia of pregnancy or of eclampsia The lesions found were apparently identical with those described in malignant hypertension It appears that the altered anatomic relations of pregnancy are prone to cause a lighting up of an old infection and that the strain of preg nancy gives this infection a distinct coloration and an explosive

character" Sternheimer and Malbin[38a] describe among the urinary leukocytes certain large cells which can be recognized by means of a stain devised by them and which they regard as characteristic of pyelonephritis Infections of the urinary tract are assuming constantly greater clinical significance

The *dietary treatment* of pyelitis and of infections of other parts of the urinary tract has been largely superseded by the use of sulfanilamides and streptomycin, the latter drug is most effective when the infecting organism is of the aerobacter group [39] Pool and Cook[40] conclude that for the routine treatment of infections of the urinary tract mandelic acid and the sulfonamide compounds are still the drugs of choice Dietotherapy, however, often adds effectiveness to these agents The object is to increase the acidity of the urine to a point at which growth of the infecting organism is inhibited, a point believed to be represented by a concentration of betahydroxybutyric acid of 0 5 per cent and an acidity of the urine of *p*H 5 2 An example of the effectiveness of such a diet is seen in the reports of Clark,[41] who in twelve days accomplished remarkable improvement in a patient with recurrent cystitis and pyelitis with elimination of the infecting organism from the urine, and who subsequently produced satisfactory results in two thirds of a group of 200 patients with infections of the urinary tract Others have written of similar results

The conventional ketogenic diets present many difficulties, and in their effort to obviate these, Nesbit and McDonnell[42] found that sufficient degrees of ketosis could be obtained with diets reasonably low in fats provided they were also low in calories In his discussion of the present status of dietary treatment in infections of the urinary tract Clark describes in detail three types of diet which may be useful (*a*) the elaborate ketogenic diet, which is seldom used because of its difficulties (*b*) the simplified ketogenic diet and (*c*) the low caloric ketogenic diet The first of these will be described in the section on Epilepsy (Chap 26) the simplified diet and the menu plan of Nesbit and McDonnell are as follows

**Menu Plan for Ketogenic Diet** (Nesbit and McDonnell[42])

Breakfast
- 1 egg
- 2 long strips of bacon
- 1 tablespoonful of cream or milk
- ½ cup of cooked 5% vegetable
- * Bran wafers as desired
- Butter as desired
- Tea or coffee

Luncheon
- 2 eggs or 2 ounces of meat or fish or 3 tablespoonfuls of cottage cheese
- ⅓ cup of cooked or ½ cup of raw 5% vegetable or 5% fruit
- 1 tablespoonful of cream or milk
- * Bran wafers as desired
- Butter or mayonnaise as desired
- Tea or coffee

Dinner the same as luncheon

Sample menus for day

Breakfast

1 egg fried with 2 strips of bacon
½ cup of tomato juice
Bran wafer with butter
Coffee with 1 tablespoonful of cream

Luncheon

3 tablespoonfuls of cottage cheese
½ head of lettuce with 2 tablespoons of mayonnaise
Bran wafers with butter
Coffee or tea with 1 tablespoonful of cream

Dinner

2 ounces of steak
Cooked spinach ¼ cup with butter
2 stalks of raw celery
Bran wafer with butter
Coffee or tea with 1 tablespoonful of cream

No sugar is allowed Chewing gum chewing tobacco toothpaste sweetened cathartics and the like are not allowed Gluside may be used for sweetening Fruits must be fresh or canned without sugar Mayonnaise should be made without sugar

* Bran wafers must have no food value

Table 87 Menu Plan of Simplified Ketogenic Diet (Clark[41])

Include the following foods daily in the exact amounts specified

| | |
|---|---|
| Heavy whipping cream | 1½ pints (3 cups) |
| Eggs | Six |

Any combination of two eggs and one cup may be used at each meal Below are three suggestions If desired some cream may be used between meals with coffee or tea

| | |
|---|---|
| **Breakfast** | |
| Scrambled eggs | |
| Eggs | 2 |
| Heavy whipping cream | ¾ cup |
| Bran wafers | As desired |
| Heavy whipping cream | ¼ cup |
| Butter | As desired |
| Coffee or tea | As desired |
| **Lunch** | |
| Poached egg | 1 |
| Baked custard or custard ice cream | |
| Egg | 1 |
| Heavy whipping cream | 1 cup |
| Water | ¼ cup |
| Nutmeg and saccharin | If desired |
| Bran wafers | As desired |
| Butter | As desired |
| **Dinner** | |
| Egg omelet | |
| Eggs | 2 |
| Heavy whipping cream | ½ cup |
| Bran wafers | As desired |
| Iced coffee | |
| Coffee | As desired |
| Heavy whipping cream | ½ cup |
| Butter | As desired |

**Table 88 Foods in Which Acid Forming Elements* Predominate**

| Food (Edible Portion) | Approximate Potential Acidity (cc. Normal Acid) Per 100 Gm | Per 100 Calories |
|---|---|---|
| Beef clear lean | 12 | 10 |
| Round steak | 11 | 7 |
| Eggs | 11 | 7 |
| Oysters | 15 | 30 |
| Oatmeal | 12 | 3 |
| Rice | 9 | 2 |
| Wheat entire | 12 | 3 |
| Wheat flour | 9 | 2 |
| White bread made with water | 6 | 2 |

* (From Sherman H C Chemistry of Food and Nutrition By permission of The Macmillan Co Publishers)

**Table 89 Foods in Which Base Forming Elements* Predominate**

| Food (Edible Portion) | Approximate Potential Reserve Alkalinity (cc Normal Alkali) Per 100 Gm | Per 100 Calories |
|---|---|---|
| Apples | 3 | 6 |
| Bananas | 8 | 8 |
| Beans dried | 10 | 3 |
| String fresh | 5 | 13 |
| Beet fresh | 10 | 25 |
| Cantaloupe | 7 | 18 |
| Carrots | 14 | 30 |
| Citron | 9 | 3 |
| Dates | 9 | 3 |
| Lemon or juice | 4 | 10 |
| Olives | 45 | 18 |
| Onions | 1 | 2 |
| Orange or juice | 5 | 10 |
| Pears fresh | 4 | 5 |
| Potatoes | 9 | 10 |
| Radishes | 5 | 23 |
| Rutabagas | 8 | 29 |
| Sweet potatoes | 6 | 5 |
| Tomatoes | 5 | 24 |
| Turnips | 11 | 33 |
| Watermelon | 4 | 12 |

* (From Sherman H C Chemistry of Food and Nutrition By permission of The Macmillan Co Publishers)

## BASE FORMING DIETS

The acid forming and base forming qualities of the food are believed by many clinicians to influence materially the course of nephritis Sansum Blatherwick and Smith[43] saw marked improvement following the use of diets which are predominatingly basic

**Table 90 A Basic (Alkaline) Diet** (Sansum Blatherwick and Smith[43])

Breakfast
Baked apple with cream
Bacon
½ slice of toast Jelly Butter
1 glass of orange juice 1 glass of milk

Lunch

Baked stuffed potato
Beets in cream
Combination vegetable salad
½ slice of bread
Butter
Olives
Iced Cantaloupe
1 glass of orange juice
1 glass of milk

Dinner

Cream of spinach soup
Escalloped potatoes
Buttered peas and carrots
California fruit salad
½ slice of bread
Butter
Apricot ice cream
1 glass of orange juice
Raisins
Nuts

### Hydronephrosis and Tumors

These disorders of the kidney require only such dietary regulation as is made necessary by the resulting impairment of renal function and the general debility Diets suitable in renal impairment were discussed *with chronic nephritis*

### Other Urinary Abnormalities

The colloids of the urine enable it to hold crystalloids in solution in much greater concentration than otherwise would be possible which explains why the phosphates oxalates and urates dissolved in the urine greatly exceed what would be the saturation point of a simple watery solution *In those disorders in which these salts are precipitated from* the urine in abnormal quantities the fault is not primarily in their concentration most often the concentration does not transcend normal limits Most important perhaps is some change in the physicochemical equilibrium of colloids and salts which impairs the protective influence of the colloids and thus permits a state of relative supersaturation to obtain

**Phosphaturia** Phosphaturia is a term which signifies a milky or *cloudy appearance of the urine due to the presence of large amounts of phosphate crystals* This is not a disease but a metabolic disturbance which may occur under a variety of conditions It is frequently seen in emotional persons or those who have been under severe mental strain in these cases it possibly indicates a disturbance in the nervous control of the regulatory function of the kidney which influences acid base equilibrium

The *treatment* of phosphaturia consists not only in allaying any possible nervousness *which the patient may exhibit* (barbiturates) but also in prescribing an acid forming diet which at the same time is low in calcium Such calcium poor foods as meat bread and cereals should be eaten liberally and those which are rich in this element such as milk eggs and the green vegetables should as far as is consistent with good nutrition be avoided At the same time the effort should be made to increase the acidity of the urine

**Oxaluria** This is a *condition in which relatively* large amounts of calcium oxalate crystals are precipitated in the freshly voided urine

These crystals form a large part of most renal stones This precipitation of calcium oxalate crystals is relatively independent of the reaction of the urine and of the concentration of these salts It may obtain in both acid and alkaline urine and in urine which contains no more than the normal amount of dissolved oxalates No doubt a markedly increased output of oxalate can be a favoring factor but the chief factor according to present day views is a lessening of the solvent power of the urine for this salt This is the accompaniment probably of a disturbance in the physicochemical state of the urine the nature of which is unknown

Clark[41] states that because of the presence of an unusual flora in the intestinal tract oxalic acid may result from carbohydrate fermentation and he suggests that the prolonged ingestion of yeast may have such an effect

The *dietary regulation* of oxaluria consists in the restriction of those foods rich in oxalates In this respect foods may be grouped as follows (1) Spinach potatoes beans endives tomatoes dried figs plums strawberries cocoa chocolate and tea are rich in oxalates and should be avoided (2) Bread the muscle meats liver sweetbreads and cereals contain oxalic acid only in small amounts and therefore may be eaten in moderation (3) Milk cheese eggs butter and other fats peas rice cabbage cauliflower asparagus mushrooms apricots grapes and melons contain little if any oxalic acid and therefore may be taken in liberal amounts

Uraturia Urataria is a condition in which uric acid or urates are deposited in large quantities in the urine This occurs only when the urine is acid Most often the fault in this condition is not in the concentration of the urine in uric acid but rather in a change in its solvent powers Uraturia should be clearly distinguished from gout although they may occur simultaneously in the same patient The brick dust sediment of uraturia is easily recognized it disappears with moderate heating The crystals of sodium urate found in this sediment vary greatly in size they may appear in whetstone form or as rosettes

The *diet* in uraturia should as far as possible be purine free The dietary regulations advised in gout are entirely suitable in this disease their chief feature is rigid limitation of meat particularly of glandular organs Milk and eggs are permitted Large quantities of water preferably alkaline waters should be taken

**Alkaptonuria** Alkaptonuria is a disease of intermediary metabolism in which the urine on standing becomes dark because of the presence of homogentisic acid This acid is probably a product of normal metabolism which has escaped oxidation and accumulating in the blood and tissues is excreted in the urine Eventually it manifests itself in other ways also by discoloration of the cartilages and occasionally by chronic arthritis The seat of destruction of homogentisic acid is believed to be the liver and the metabolic fault of this disease is probably to be found in this organ

There is a familial tendency toward alkaptonuria which fact leads to the belief that it is an inherited anomaly It is probably always

congenital and belongs among what have been called the 'inborn errors of metabolism'"[43]

The *recognition* of this disease is made easy by the black discoloration which the urine assumes on standing (*ammoniacal fermentation*) or on the addition of a few drops of 10 per cent solution of sodium hydroxide

The *treatment* is aimed at the limitation of the formation of homogentisic acid Since this acid is derived from the amino acids, tyrosine and phenylalanine, it is necessary to curtail their intake as far as possible The exogenous supply of these bodies can be materially limited but the endogenous supply of protein cleavage products and the amino acids derived from them cannot be stopped Protein metabolism should be reduced to the lowest figure compatible with nutritive safety It is not feasible to draw distinctions as to the kind of protein eaten except as regards milk and milk products, for casein is especially rich in tyrosine, therefore the adult patient with this disease should take as little as possible of milk, cream and cheese The child, however, is so dependent upon milk that even in the presence of alkaptonuria he should be permitted a small quantity, about 1 pint daily The adult can to a certain extent compensate for his abstinence from milk by eating large quantities of green vegetables, such as lettuce, spinach cabbage, cauliflower and the like, and secure his minerals and vitamins from these sources

The degree to which the restriction of protein can safely be carried is difficult always to determine (See Chapter 4) It is not wise to eliminate protein altogether from the diet and thus force the patient to consume his own tissue proteins It is best to permit him a certain minimal intake, the smallest amount which according to estimate will preserve nitrogen balance and insure nutritive safety This is 0 66 to 0 75 gm of good protein per kilogram of body weight per day In a child the allowance should be at least 1 gm Thus for a man of 70 kilograms, 45 to 50 gm of good protein daily would be appropriate In order to accomplish this reduction in protein without damage, it is important that the diet in other respects be fully adequate and that at least 50 per cent of its total energy be in the form of carbohydrate The patient should be given an abundance of *cereals, bread and sweets* and, to insure sufficient minerals and vitamins, an abundance of *fruits and green vegetables*

**Cystinuria** Cystine does not normally appear in the urine except perhaps in minute traces In the disease known as cystinuria there is some defect of metabolism which permits cystine to escape oxidation and to accumulate in the tissues It is excreted in the urine, where it appears in crystal form and may lead to the production of calculi Lewis and Lough[44] found that the excretion of cystine by their cystinuric patients varied with the total nitrogen excretion and appeared to be independent of the cystine content of the diet From this they tentatively concluded that the increased cystinuria which accompanies high protein diets in these patients expresses the stimulation by protein of some process of endogenous metabolism which leads to the production

of cystine rather than a mere failure to oxidize the increased amounts of cystine which accompany a high protein intake Brand and his associates[45] observed that the urine of a cystinuric patient failed to give the Sullivan reaction which is specific for free cystine until the excreted fluid has stood for some time which led to the conclusion that in this instance cystine was excreted in a combination which was split only after standing These researchers suggested that digestive hydrolysis of the protein molecule is not always complete and that cystine may be absorbed from the intestinal tract in the form of a higher complex and not as the free amino acid

In the severer form of cystinuria particularly if the intake of protein has been excessive other amino acids notably tyrosine asparagine arginine and lysine may appear in the urine In the milder forms of the disease however the metabolic disturbance appears to be limited merely to a failure to oxidize the sulfur carrying amino acid cystine

The *diagnosis* is made by examination of the urinary sediment Because cystine is soluble with difficulty it is readily precipitated from the urine it appears in the form of small flat hexagonal crystals If the cystine is still in solution a few drops of acetic acid will cause its crystals to appear These crystals are readily soluble in ammonia and hydrochloric acid and are insoluble in water acetic acid and ether The nitroprusside test is confirmatory

This disorder may not be accompanied by symptoms As a rule however the crystals are deposited in the kidneys and at other locations in the urinary tract and eventually produce symptoms Cystine calculi may form in any part of the urinary tract and the resulting symptoms do not differ from those produced by other calculi The rapidity of their growth and their location determine in large measure the symptoms

The *treatment* of cystinuria is similar to that of alkaptonuria This sulfur carrying amino acid is a constituent of all food proteins By rigidly curtailing the intake of protein one can lessen the amount of cystine which comes from food but one cannot reduce beyond a certain point the endogenous supply which comes from the destruction of the patient s own tissues The diet outline for alkaptonuria is entirely suitable for cystinuria except in one respect The objection to milk noted in alkaptonuria does not hold good in cystinuria milk need not be restricted further than is indicated by its protein content Klemperer and Jacoby and Smillie reported satisfactory results in the treatment of this metabolic anomaly by means of restriction of protein and the administration of large amounts of alkali These observers recommend that the urine be kept at all times alkaline to litmus This may be accomplished by the administration of large amounts (4 to 6 gm daily) of sodium bicarbonate In addition the patient should drink large quantities of water

## RENAL STONES

Renal stones are of three groups phosphate oxalate and urate Usually they contain all three salts but one or another may predominate Oxalate and urate calculi develop as a rule in acid urine the oxalates

usually predominate Phosphatic calculi often develop in the alkaline sediment of an infected urinary tract It is difficult to say how much can be accomplished by dietary restriction Persons whose families show a tendency toward the development of renal stones should as a prophylactic measure practice dietary restriction The claim has been made that urinary calculi can be retarded in growth and even dissolved by means of a diet rich in vitamins with a predominantly acid ash but this has found little support Oppenheimer and Pollack[46] report that in their hands such a diet failed to cause the disappearance or reduction in size of renal calculi of the alkaline earth type In his excellent review Lattimer[47] asks the question 'Can stones be dissolved by diet? and answers Yes, they can be, but very rarely Cystine stones if pure will sometimes after many weeks dissolve in a strongly alkaline urine Many alkaline stones will dissolve with an acid ash diet, but Lattimer comments that instead of such a diet it is much easier for a patient to take ammonium chloride or nitrate The diets suitable for the several forms of renal stone have been discussed under phosphaturia, oxaluria and uraturia

*Nephrocalcinosis* is a term used to describe bilateral, diffuse calcifications in the renal parenchyma, usually in the pyramids, which can be demonstrated in the roentgenogram The nature of the diet is probably of no influence Engel[48] believes that this is the result of localized renal damage, chiefly of the distal convoluted tubules, and that many cases are due to the direct toxic action of sulfonamides The lesson is obvious

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# 20

## *Diseases of the Digestive Organs*

### ESOPHAGEAL DISORDERS

*Acute ulcerative esophagitis,* which occurs as a rule in debilitated persons, was found by Bartels[1] in 0 013 per cent of 6000 autopsies Pain in the esophagus and vomiting are common symptoms Unfortunately the vomiting, because of the acidity of the gastric contents thrown into the esophagus, serves to perpetuate the condition

*Peptic ulcer* of the esophagus is said to be the result primarily of a functional disorder of the vegetative nervous system which leads to vascular spasm and in consequence to localized interference with nutrition Regurgitation of acid gastric contents plays a part, but this is apparently of secondary importance The chief symptom is pain under the lower end of the sternum which sometimes radiates into the back It may appear a short time after meals, but more often it is present during meals especially if solid food is eaten This condition is relatively rare and the esophagoscope offers the best means of diagnosis

The diet in each of these conditions, as in ulcer of the stomach, should consist of liquids taken at intervals of one or two hours and should include largely milk or milk and eggs, with the addition later of thin gruels Every effort should be made within the limitations of the regimen, to improve the patient s nutritive state

*Esophageal obstruction* may be produced by pressure from adjacent structures as from an aneurysm or a mediastinal growth, or from intraesophageal disturbances, such as carcinoma, cicatricial contraction, cardiospasm diverticula and foreign bodies

A danger incident to every esophageal obstruction particularly if it is from cancer, is starvation The first effort always should be to give food through the natural channels, but if sufficient nourishment to meet the patient's needs cannot be taken in this manner and starvation is imminent, then a gastrostomy opening should be made Skilful dilation begun early, will often obviate this operation

The treatment, whether by dilation, irradiation or otherwise, is determined by the nature of the obstruction, but the diet should be essentially the same whatever the cause The food in organic stenosis should be liquid and semiliquid Milk (1 or 2 quarts daily), cream and raw or soft boiled eggs are the usual foods When the stenosis is not

marked milk toast cereals with cream and purees may also be given Cream may be added to the milk up to one third of its volume provided this mixture is not too rich for the patient s comfort It is best to give small amounts of food at frequent intervals which is especially to be recommended when regurgitation occurs small amounts of liquid (1 tablespoonful) will sometimes find passage into the stomach when larger amounts would be regurgitated

When the stenosis appears to be so great that little or no food can be taken it does not necessarily follow that final obstruction is at hand for superimposed inflammatory swelling will occasionally cause complete obstruction which subsides when the patient is given a short rest from instrumentation and feeding by mouth When the obstruction permanently reaches the point at which sufficient nourishment cannot be given by mouth gastrostomy should be performed

*Cardiospasm with dilatation of the esophagus above the obstruction* is apparently due not as is usually assumed to a thickened sphincter or hypertrophied muscle but according to the studies of Lendrum[9] to loss or complete absence of ganglion cells from the myenteric plexus As a result the action of the sympathetic fibers is unopposed and the esophagus fails to relax normally with the swallowing reflex Subsequently the long continued pressure from within leads to a thinning of the muscles above and eventually to enormous dilatation of the esophagus Cardiospasm can usually be recognized by the following characteristics the obstruction is likely to be more complete than with organic stricture and the proximal dilatation greater it varies in severity from time to time occasionally in cases of this type of obstruction solids can be more easily swallowed than liquids Operative stretching or gradual dilation by means of a rubber bag designed for this purpose will often give relief for long periods Excessively hot or cold drinks should be avoided otherwise no special dietary precautions are to be observed

## GASTRITIS

**Acute Gastritis** This condition always demands the same dietary regulation whether it comes from *(a)* gross errors in diet *(b)* some ingested poison bacterial or mineral or *(c)* the toxin of an infectious disease If either of the first two causes is still operative when the patient is first seen the stomach should be emptied promptly by lavage Thorough washing with a large quantity of water containing a little sodium bicarbonate will remove all food remnants and mucus and in cases of milder involvement will accomplish much toward recovery After the stomach has been thoroughly emptied it may be well to hasten the cleansing process by irrigating the colon Subsequent purgation by means of castor oil or some saline laxative is also advisable

For a time no food should be given The stomach exhibits wonderful recuperative powers when permitted to rest and if no food is forced on it for a period of twenty four to forty eight hours and the original cause of the gastritis is no longer operative it will as a rule promptly recover Even the water taken by mouth should be restricted To re

lieve thirst the patient may take cracked ice small quantities of hot water or perhaps small amounts of carbonated water If there is nausea or if prostration is profound a little dilute alcohol in the form of champagne or whisky diluted with carbonated water should be given every three or four hours In the cases of severer involvement plain tap water or dextrose solution by rectum by the Murphy drip method should be given Recovery is hastened if the patient is kept in bed

After one or two days feeding is usually begun Milk is the best food Broths thickened with rice or some other cereal may be taken but milk milk toast and cereals with cream are to be preferred to the more stimulating broths A soft diet bland and nonirritating should be continued for a week or ten days and perhaps longer Milk cereals with cream toast butter preserves fruit juices baked apple rice pudding tapioca pudding cup custard and soft boiled or poached eggs meet these specifications For several weeks all woody vegetables and other coarse foods should be avoided Only tender meats should be taken

When as in infectious diseases the cause of the gastritis persists the liquid diet should be continued

**Chronic Gastritis** Chronic gastritis was once a commonly recognized clinical entity then for many years its existence was largely denied Now since the advent of the gastroscope the disease is believed to be of relatively frequent occurrence Of 2500 patients with abdominal complaints examined gastroscopically by Schindler and his associates[3] 50 per cent presented mucosal changes similar to those of chronic inflammation of other mucous membranes These authors describe areas similar in appearance to those seen by Beaumont years ago and from the appearance of the mucous membrane they recognize four forms of gastritis superficial atrophic hypertrophic and postoperative Jones[4] warns however that lesions sometimes called atrophic gastritis may in reality be an expression of avitaminosis comparable to the lesions of similar appearance seen in the tongue and adds a protesting note against the too enthusiastic use of the gastroscope There are many difficulties inherent in the classification of gastritis

The *cause* of chronic gastritis is shrouded in doubt True it can sometimes be related directly to dietary indiscretions the use of irritating drugs or excessive indulgence in alcohol or indirectly to diseases located elsewhere such as tuberculosis syphilis or uremia In many instances however no such cause can be identified Chronic alcoholic addicts have chronic gastritis and present the disease in its typical form Among the irritating drugs which may be responsible salicylates iodides and drastic purgatives take a prominent place Among the faulty dietary habits which are regarded as etiologic factors may be included the use of highly seasoned foods and of very hot or cold drinks rapid eating with poor mastication overloading of the stomach and a preference for coarse foods (vegetarian diets) Prominent among the indirect causes are pulmonary tuberculosis and syphilis Various other chronic diseases notably cirrhosis of the liver nephritis diabetes myocardial failure and polyarthritis may be accompanied by gastritis The suggestion has been made that chronic atrophic gastritis is sometimes a pre

cancerous lesion, but the careful anatomic studies of Guiss and Stewart[5] speak against any such relationship. The significance of the disease and its relation to achylia gastrica as well as to pernicious anemia and other disorders of the achlorhydria group are not clear.

The *symptoms* vary and are not as a rule characteristic. The appetite is usually poor, but not invariably so. The distress is epigastric, and while there is often a certain periodicity, this is not so marked as in ulcer. Schindler and his associates found that in the atrophic form the pain appeared from one to thirty minutes after meals, while in the superficial and hypertrophic forms it was more delayed. Alkalis gave relief in about half the latter group. Aggravation by large amounts of food or by special food was infrequently found. Abdominal distention and eructation of gas were common. To distinguish chronic gastritis from "nervous dyspepsia," on the one hand, and from peptic ulcer or early carcinoma, on the other, is not always easy.

*Physical examination* reveals nothing significant in chronic gastritis except perhaps the tender zone below and to the left of the umbilicus described by Schindler. *Gastric analysis is apparently of little diagnostic* help, because, contrary to the usual belief, free hydrochloric acid, sometimes in increased amounts, is frequently found, and the characteristic presence of an increased amount of mucus is by no means constant. Likewise, the roentgenographic "relief technic" has not given material help. Of greatest help in diagnosis is the gastroscope. The reader is referred to the numerous technical articles dealing with this method of examination.

The *dietary treatment* of chronic gastritis demands first the correction of dietary faults. *The meals should be eaten slowly, and the food should* be thoroughly masticated. No food which is difficult to masticate should be permitted. If the teeth are at fault, as is frequently the case, they should be taken care of, and missing teeth should be replaced by artificial appliances. Since the act of mastication stimulates the flow of gastric juice, it is obviously much better to prescribe foods which must be chewed and thus to induce an increased flow of hydrochloric acid whenever possible than to administer the necessary acid by mouth. *No alcohol should be permitted, or, if the patient is an alcoholic addict, only small amounts with the meals.* The food should be of the smooth variety, given at frequent intervals.

Milk is a good food in chronic gastritis. Schindler advises against it in cases of the atrophic form, and others have expressed themselves likewise, but in my experience it has been satisfactory. The constipation which it is said sometimes to cause can be corrected by the use of agar or magnesium hydroxide. The diarrhea which it may produce is usually dependent on the accompanying achylia and can as a rule be corrected by the administration of hydrochloric acid.

Too much food should not be taken at one time, and to this end it is sometimes advisable to give milk or milk and egg at stated intervals between meals. All foods should be carefully prepared and coarse particles excluded. Coarse, woody or stringy vegetables, tough meats and bran or whole wheat should not be permitted. Gruels made of rolled

oats Farina and Cream of Wheat are excellent and are well borne by the stomach but in addition carbohydrate foods which require mastication must also be given toast is excellent for this purpose since it requires chewing and at the same time is of easy chymification It is sometimes well to insist that a good part of the carbohydrate be in the form of dry toast

Vegetables should be served as purées and in this form can be taken in liberal amounts Likewise fruits should be eaten cooked Apples and raw fruits are usually harmful but thoroughly ripe (spotted) bananas are contrary to popular belief well borne Fruit juices may be taken among which orange juice because of its vitamin content should have a prominent place

The protein of the diet should come largely from milk and eggs and to a less extent from tender meats Eggs may be taken in any form except fried or raw fried eggs are greasy and raw eggs are indigestible Any meat except pork is suitable but it must be well prepared and tender There is no difference in this connection between white and dark meats Meat stews if not too highly seasoned are excellent Dried and smoked meats should be avoided

Fats are preferably taken in the form of butter and cream Crisp bacon in small amounts is often good

The correction of constipation is sometimes demanded Drugs are bad and it is inadvisable in this disease to give the coarse foods usually prescribed for constipation such as bran graham bread and bulky vegetables Two remedies are appropriate mineral oil and when obtainable plain agar Dilute hydrochloric acid should be given when there is low gastric acidity or achylia In the latter instance liver extract given parenterally is often of benefit

When there is hyperacidity more protein foods in the form of eggs and finely chopped meats are desirable or the diet advised for the later weeks of gastric ulcer may be suitable All foods which stimulate gastric acidity such as broths meat soups and highly seasoned foods should be studiously avoided

The bland diets detailed on pages 404 409 are useful in the therapy of gastritis

## DUODENITIS

Duodenitis is not easily distinguished from duodenal ulcer Indeed the two conditions often occur together or one follows the other The symptoms of the former are less constantly typical and are less often relieved by food than are those of the latter In only one fourth of the cases reported by Kirklin[6] were the roentgenographic signs definite These included hyperirritability great spasticity and hypermotility of the duodenum with rapid variations in the deformed bulb Duodenitis should be treated with the dietary regimen given for duodenal ulcer

## GASTRIC AND DUODENAL ULCERS

For the purposes of this book gastric and duodenal ulcers can be considered together True there are certain differences in their clinical and

roentgenographic manifestations, but, except for the possibility of carcinoma *in the former, the pathology is the same* The seats of predilection, the pars pylorica and the pars horizontalis superior, are biologically the same These ulcers have the same pathogenesis, cause essentially the same symptoms, and are subject to the same corrosive influence of the digestive juices The two respond to the same type of treatment and therefore demand in principle the same dietary regulation

The same applies in large measure to *ulcer of the jejunum,* which sometimes follows gastroenterostomy for duodenal ulcer It is strikingly similar in its pathologic picture and symptoms to the original ulcer and *is subject to the same hazards* of hemorrhage and perforation The diagnosis is not always easy, and before the patient is subjected to operation he should be given rigid dietary treatment, *which is the same as that* advised for gastroduodenal ulcer

**Incidence** The incidence of peptic ulcer in the urban population of this country, as shown in the studies of Portis and Jaffé,[7] is approximately 5 per cent In 9171 necropsies performed at the Cook County Hospital in Chicago, these authors found 457 cases of this disease It was also found that the peak of the incidence of these ulcers was during the age period when arteriosclerotic changes are most common

**Cause** The cause of peptic ulcer is unknown It is not improbable *that this ulcer is multiple in origin and that the several causative factors* combine in varying degrees to produce it These have been grouped as follows (1) local trauma, (2) lowered resistance of the tissues to the digestive action of gastric chyme, and (3) systemic influences The influence of trauma was well described by Cheever[8] as a combination of vigorous muscular action and poorly masticated food, with the result that these frequent minor traumatisms of the mucosa with slight autodigestion *of the devitalized tissue lead ultimately to chronic indurated* peptic ulcer Traumatism is probably the least important factor of the three, but in rare instances it has seemed to be the dominating one

The digestive action of the gastric juice is apparently an essential factor in the production of an ulcer[9] Pure gastric juice, as was pointed out by Dragstedt,[10] is capable of destroying all living tissue, including the wall of the stomach This action of the pure juice is much more aggressive than that of the usual gastric content which is diluted with mucus, saliva and swallowed food True, there is a small but constant *secretion of gastric juice* at all times but it is assumed that the stomach wall is protected ordinarily by a neutralizing mechanism Under certain circumstances this may fail, or under nervous influences there may be such a hypersecretion of gastric juice as to render this mechanism inadequate In either event, digestion of the gastric mucosa with resulting ulceration may occur The degree of acidity seems to bear *no direct* relationship to the activity of the ulcer or to the frequency of recurrences,[11] but the *preponderance of clinical evidence* indicates that in the presence of complete achlorhydria chronic ulcer does not occur[11a]

Among the systemic factors nutritive deficiency and other debilitating disorders should properly be included but as a rule these are not important, Attention has been called to the low ascorbic acid values some-

times obtained for the blood of patients with ulcer, but a critical scrutiny of the evidence presented and of the diets upon which these patients subsist leads to the conclusion that hypovitaminosis is the result rather than the cause of the ulcer Elder and Emery[12] expressed the generally accepted view when they stated as their conclusion that peptic ulcer is not fundamentally a deficiency disease

Nervous and emotional factors and constitutional predisposition play a prominent role often a determining role, in the production of ulcer The older neurogenic theory of ulcer production finds support in the observations of Cushing and in the experiments of Keller,[13] who by injuring the midbrain of dogs was able to produce erosions of the gastric mucosa Further support is found in the report of Boles and Riggs that no pathologic difference between the acute gastric ulcer associated with intracerebral disease and that not associated with such disease was seen in their studies of fifteen cases of the former type The neurogenic disorder giving rise to the ulcer can conceivably be either organic or functional It is not difficult to conceive of spasm and localized areas of ischemia in the gastric and duodenal mucosa produced by functional derangements of the autonomic nervous system which in turn are themselves precipitated by psychic or emotional influences Such areas lose their resistance to the eroding influence of the gastric chyme and eventually a chronic ulcer results Careful questioning will sometimes reveal the fact that symptoms of ulcer first appeared when the patient was under the influence of emotional strain or psychic trauma Instances are numerous in which the entire syndrome of ulcer seems to be related in its inception and course to disturbances of the nervous system

The importance of the constitutional factor was first seen by Eppinger and Hess [14] who wrote of the excitable hypersensitive nature, the cold clammy hands and the other evidences of vagotonia often seen in patients with ulcer and more recently Draper[15] has described the anatomic and physiologic peculiarities of these patients In emphasizing the importance of the constitutional factor Crohn[16] writes The unknown factor which causes chronic indigestion and dyspepsia in one patient and ulcer in another has not yet been determined Perhaps as has been said by many writers this factor is in the hypothalamus or the autonomic nervous system

In summary clinical and experimental evidence indicates that gastric and duodenal ulcers develop when resistance to the erosive action of the digestive juices is lowered This condition can be brought about both by trauma and by the ischemia which comes from functional disorders of the autonomic nervous system These last influences are often psychic or emotional in origin

**Diagnosis** The recognition of peptic ulcer in the majority of cases is not difficult The epigastric pain is characteristic it is a true hunger pain often described as burning piercing or boring coming on practically always at the same time after meals frequently several hours later Gastric hyperacidity is frequent as is the presence of occult blood in the feces The persistence of symptoms through weeks months and years with occasional periods of remission gives a certain periodicity

Occasionally the ulcer will be latent and reveal its presence first by a copious hemorrhage or only at autopsy As a rule, however, the chronic ulcer will pursue a typical course and produce characteristic symptoms Roentgenographic study gives valuable information

**Earlier Methods of Treatment** The methods of treatment which have been devised are numerous The classic treatment many years ago was the semistarvation regimen of von Leube, within ten years this clinician himself treated more than 1000 patients by this method This was superseded in popularity in 1904 by the diet recommended by Lenhartz, which contains more albumin and is of higher caloric value Numerous modifications of the latter treatment were devised, the best one being the regimen introduced by Sippy Although broader diets are now in vogue, the general rules laid down by Sippy still hold good and his regimen is still of interest

The *Sippy treatment* was proposed in 1915 Sippy[17] had then used this method for more than twelve years, with results 'far beyond early expectations" He reasoned that the failure of an ulcer to heal is due to the digestive action of the gastric juice and that neutralization or removal of the hydrochloric acid would prevent this action His treatment, therefore, includes not only rest and rigid dietary control, but also gastric lavage and the use of large amounts of alkali The endeavor is to render the digestive action of the gastric juices inert during the entire period when the food and the accompanying secretion are in the stomach, that is, from 7 A M until 10 P M In the beginning the stomach tube is passed each evening at bedtime to determine whether there is an excessive night secretion, such as accompanies pyloric obstruction If the gastric contents exceed the normal quantity (about 10 cc), the stomach is washed out, and this is repeated each night until evidences of obstruction disappear and the irritative secretory activity has subsided Sippy laid great emphasis on the importance of this procedure

The patient should as a rule remain in bed for three or four weeks

Feeding is begun immediately, without any preliminary period of starvation The plan of diet which Sippy found most adaptable was as follows:

> Three ounces of a mixture of equal parts of milk and cream are given every hour from 7 A M until 7 P M After two or three days soft eggs and well cooked cereals are gradually added until at the end of about ten days the patient is receiving approximately the following nourishment 3 ounces of the milk and cream mixture every hour from 7 A M until 7 P M In addition three soft eggs one at a time and 9 ounces of a cereal 3 ounces at one feeding may be given each day The cereal is measured after it is prepared
>
> Cream soups of various kinds vegetable purees and other soft foods may be substituted now and then as desired The total bulk at any one feeding while food is taken every hour should not exceed 6 ounces Many of the feedings will not equal that quantity The patient should be weighed If desired a sufficient quantity of food may be given to cause a gain of 2 or 3 pounds each week

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and vegetable purées
since it interferes witl
contents

The acidity is more easily controlled by feeding every hour and giving the alkalis midway between feedings The acidity may however, be controlled by feeding every two three and four hours

Neutralization of the hydrochloric acid was accomplished by the administration of one of the following alkaline powders every hour between feedings powder No 1, sodium bicarbonate and heavy calcined magnesia, each 10 grains, powder No 2, sodium bicarbonate and calcium carbonate, each 20 grains The powders may be alternated or they may be otherwise varied as circumstances demand Because of the dangers of alkalosis and perhaps of kidney stone, these powders are seldom used today

The results reported by Sippy, even in long standing cases of pronounced pyloric obstruction, were wonderfully satisfactory This treatment, however, presents four objectionable features (1) the half hour taking of food and medicine quickly becomes irksome, (2) the large amounts of alkali used may lead to alkalosis (3) the half and half mixture of milk and cream is too rich, and (4) the diet is low in protein and lacking in ascorbic acid If the Sippy regimen is followed, supplementation with vitamin C is essential

**Present Methods of Treatment** The tendency in recent years has been to liberalize the ulcer diet No longer is it considered necessary to adhere rigidly to all the restrictions formerly imposed Rather is it believed that the disease pursues a more favorable course and the patient gets well quicker when he is given a broader diet in which is included a liberal amount of protein The type of treatment demanded naturally varies with the severity of the disease, and each ulcer patient must be treated individually, but in general the following principles should govern

1 The *kind of food* should be such that it will allay the irritability of the stomach and neutralize the free acid Milk comes first It should often be the sole food in the beginning, the mainstay of the diet as treatment proceeds and an important adjunct to the menu for many years after a cure' has been obtained For the sake of variety and to give the milk flavor, other substances, such as cocoa and coffee are often added In my experience, however it is best to give the milk straight, without effort at camouflage Eggs are next in importance Daily from two to six may be taken raw, soft boiled or poached Next in importance come cooked cereals—oatmeal farina and Cream of Wheat—and milk toast also mashed potatoes and rice Stewed and preserved fruits with zwieback or dry toast (good mastication!) may also be given Orange juice and other fruit juices may be given after the first two weeks of treatment sometimes earlier

Amino acid mixtures in the form of protein hydrolysates have been used, but these probably have no advantage A recent reviewer[18] writes On the basis of data now available it does not appear that protein hydrolysates in treatment of peptic ulcer are of any greater value than other commonly used methods'

An antipeptic ulcer dietary factor, quickly destroyed by heat is claimed to be related to the formation and the healing of ulcers The name

'Vitamin U' has been suggested This factor is said to be present in a number of raw foods, including milk, but to be most abundant in cabbage One quart of strained juice can be obtained from 4 to 5 pounds of fresh cabbage when puréed mechanically with the addition of a little water Cheney[18a] gives 1 quart of this juice daily in about five feedings, always after other food has been taken, and reports encouraging results Appraisal of this claim cannot be made as yet

Many foods should be prohibited in ulcer cases These include broths and all meat soups, dried or smoked meats and those with tough fiber, coarse vegetables, raw fruits, piquant sauces, highly seasoned foods and all alcoholic beverages

2 *Protein foods* are believed to be of special value The experiments of Hall and Rossett[18b] would indicate that the antacid effect of the food given ulcer patients is directly proportionate to its protein content Co Tui and his associates[19] have reported astonishingly good results from the treatment of patients with peptic ulcer by feeding them at two-hour intervals a mixture of dextrimaltose and a protein hydrolysate They attributed this benefit to the antacid as well as the tissue building properties of the amino acids It is generally agreed that a high protein diet is desirable in this disease, but the necessity for giving a mixture of amino acids by mouth rather than good protein is debatable When it is deemed necessary to withhold food, however, as during hemorrhage, hydrolysates should be given intravenously

Skim milk powder is an excellent source of good protein and can with benefit be used in relatively large amounts Tender meats are well borne by the ulcer patient and can as a rule be added in the second or third week of treatment Some physicians give ground meat even after a massive hemorrhage

3 *Frequent feedings* are necessary in order to maintain neutrality of the gastric contents In severe cases hourly feedings may be necessary, although in most instances two-hourly intervals are appropriate For some patients three meals daily with between meal and bedtime feedings are adequate Whatever the schedule, punctuality should be insisted upon

4 *Alkalis*, in order further to insure neutrality, should be taken between feedings To prevent alkalosis it has become the custom to use insoluble alkalis instead of those formerly included in the Sippy powders Magnesium carbonate tribasic magnesium phosphate, tribasic calcium phosphate and magnesium trisilicate are suitable, but the most satisfactory antacid is stated by Adams[20] to be aluminum hydroxide Collins[21] also reports excellent results from the use of an aluminum hydroxide gel in the treatment of more than 3000 patients For the first month of treatment he recommends that this antacid be given every two hours during working hours, alternating with the feedings so that every hour the patient takes either food or antacid The size of the dose is never less than 2 drams As an alternate method for patients with minor symptoms who continue working he recommends the antacid only six times daily after feedings An excellent statement of the chemistry of aluminum hydroxide was given in the report of Kreider[22]

5 *Drugs* of various kinds have, from time to time, been proposed Banthine an anticholinergenic drug orally effective for the control of the vagotonia of peptic ulcer, is now used with enthusiasm by some physicians, but its ultimate value is yet to be demonstrated

6 The *correction of the constipation* which may result from lack of roughage is sometimes accomplished by the addition to the antacid at bedtime of a dram of a mixture of heavy magnesium oxide and calcium oxide, equal parts Plain agar is also used Like laxatives, high enemas stimulate gastrointestinal activity and therefore are bad If it is necessary to cleanse the lower part of the bowel in order to give fluids by rectum or for some other reason, only a small cleansing enema should be used

7 The *amount and the kind of food* should be adequate to meet all nutritive requirements, and to this end it may be necessary to add certain vitamins, notably vitamin C and thiamine in crystalline form True, orange juice tomato juice and puréed vegetables will as a rule serve this purpose but the need is urgent and should never be forgotten

8 *Caffein containing drinks* should be restricted The studies of Ivy and his associates[23] lead them to the conclusion that the excessive use of such beverages will render therapeutic management more difficult and that it may even contribute to the pathogenesis of peptic ulcer in the ulcer susceptible person

9 *Dietary regulations* should be long continued for years rather than months It is well to recognize in the beginning that in many instances it must be continued in some form throughout the remainder of the patient's life

10 *Rest* in bed is one of the best means of resting the stomach, if feasible it should be insisted on during the first two weeks of treatment It is some advantage during this period to have the patient in a hospital or nursing home for the discipline and morale of an institution facilitate the subsequent treatment On the other hand, many physicians regard ambulatory treatment in most instances as highly satisfactory

11 *Other therapeutic measures* include good hygiene, both physical and mental To teach relaxation and the relief of nervous tension is always important Indeed one expert, in stressing the importance of treating the patient as well as the ulcer, writes "Tensional states to my mind deserve greater attention than the ulcer per se unless complications intervene" It has repeatedly been observed that the patient with an ulcer improves more rapidly if he is comfortable and contented than if he is worried, homesick and uncomfortable Psychotherapy of the right sort therefore is always helpful

The patient's general physical state should receive attention Pyorrhea should be cured or kept under control dental decay stopped, teeth with apical abcess extracted and obviously diseased tonsils removed The use of alcohol and tobacco should be stopped Many physicians regard cigarettes as especially bad for these patients

*Individualization* is always necessary The directions given the patient must of necessity be varied to meet the exigencies of the case When there is pyloric obstruction, the diet must consist only of milk given

at hourly or two-hourly intervals and perhaps a little strained cereal. The gastric lavage introduced by Sippy is also advisable. For patients who have had a massive gastric hemorrhage, ground meat is given at the beginning of the treatment.

The following series of graduated bland diets were developed by Dr. Harrison Shull and Mrs. Betty Woodruff of Vanderbilt University. They are adaptable for use in a wide variety of situations and are presented here with the instructions for the patient.

### Table 91 Bland Diet No. 1

Drink 4 ounces (½ standard measuring cup) of bland diet mixture every hour from 6 A.M. through 10 P.M. and every waking hour after 10 P.M. A maximum of 4 ounces of water is allowed as desired between feedings.

Recipe for Bland Diet Mixture

5 cups (measuring) whole milk
2½ cups (measuring) light cream
17 tablespoonfuls (level) powdered skim milk

Sprinkle powdered skim milk on whole milk. Mix with rotary egg beater. Add cream. Refrigerate until about 10 minutes before drinking.

NOTE. Should be supplemented with 100-200 mg. of ascorbic acid daily.

### Table 92 Bland Diet No. 2

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than 8 ounces of food or liquid. Foods should not be extremely hot or cold. A maximum of 8 ounces of water is allowed as desired between feedings.

Foods Allowed

| | |
|---|---|
| Strained cereal gruel | Strained cream soup |
| Custard | White toast |
| Junket | Soft boiled or poached egg |
| Jello | Salt, butter and sugar to make food palatable |
| Eggnog | |
| Milk toast | |

NOTE. Should be supplemented with 100-200 mg. of ascorbic acid daily.

Example of Schedule

| | |
|---|---|
| 6 A.M. | 1 cup of bland diet mixture |
| 8 A.M. | ½ cup of strained oatmeal, ½ cup of milk |
| 10 A.M. | 1 cup of bland diet mixture |
| NOON | 1 soft cooked egg, 1 slice of buttered white toast, ¾ cup of milk |
| 2 P.M. | 1 cup of bland diet mixture |
| 4 P.M. | 1 cup of bland diet mixture |
| 6 P.M. | Milk toast, 2 slices of white toast, ¾ cup of milk |
| 8 P.M. | 1 cup of bland diet mixture |
| 10 P.M. | 1 cup of bland diet mixture |

Recipes with Foods Allowed on Bland Diet No. 2

Bland Diet Mixture

1 pint light cream
1 quart whole sweet milk
13 tablespoonfuls of powdered skim milk

Sprinkle powdered skim milk on whole milk. Mix with rotary egg beater. Add cream. Refrigerate until about 10 minutes before meal time.

### Cereal Gruel

| | |
|---|---|
| ½ cup cereal such as strained oatmeal cream of rice cream of wheat | ½ cup milk |

Mix together

### Custard

| | |
|---|---|
| 1 cup milk | 1 tablespoonful sugar |
| 1 egg | Pinch of salt and flavoring |

Beat egg slightly Add milk sugar salt and flavoring Pour into custard cups place in a pan of water bake in a moderate oven (300°) until custards are firm To test when done insert a knife if knife comes out clean the custard is done

Yield 2 servings

### Egg Nog

| | |
|---|---|
| 1 egg | ¾ cup milk |
| 2 teaspoonfuls sugar | ¼ teaspoonful vanilla |

Beat egg until thick Add sugar and beat again Add milk and vanilla Chill

### Cream Soup

| | |
|---|---|
| 1 tablespoonful margarine | ¾ cup milk |
| 1 tablespoonful flour | ¼ cup vegetable strained |
| ¼ teaspoonful salt | |

Melt butter in top of double boiler Stir in flour to make paste Add milk slowly stirring constantly Cook over hot water until it thickens Add strained vegetable

### Table 93 Bland Diet No 3

A maximum of 16 ounces ( 2 standard measuring cups) of foods selected from the list below is to be taken 6 times a day at regular intervals

#### Foods Allowed

Soup

Homemade cream soup made from strained carrots asparagus spinach beets peas or tomatoes *Do not use commercial soups or meat broths*

Meat Poultry Fish

Ground beef ground liver ground lamb ground veal
Boned and flaked white fish
Chicken (white meat)
Meat poultry and fish must be baked boiled or broiled *Do not include smoked or processed meats such as sausage ham bologna cured pork frankfurters, potted meats, tuna fish, duck*

Potatoes

White potatoes mashed or baked

Vegetables

[illegible]

*okra commercial tomato paste*

Vitamin C

Strained orange juice or tomato juice (fresh canned or frozen)

Eggs

Baked boiled poached or shirred *No fried eggs*

Fats

Butter or margarine

Milk Cream

Sweet milk, buttermilk, malted milk or cocoa Cream as desired

Cheese

Mild American, cream or cottage cheese Mild American cheese may be used in sauce for Rusk, toast and to combine with macaroni, spaghetti or noodles *Do not use sharp flavored or spiced cheese*

Bread and Cereals

White toast, melba toast, Zweibach, Holland Rusk *Do not use hot breads rolls, biscuits, cornbread, whole wheat or bran bread*

Strained oatmeal, cream of wheat, rice, macaroni, noodles grits cornflakes Rice Krispies puffed rice

Fruits

Mashed ripe bananas, strained pears apples peaches prunes apricots *Do not use raw fruits, except bananas, and all fruits with skins and seeds, such as berries of any kind*

Miscellaneous

1 Desserts—Plain custard, junket, Jello cornstarch rice or tapioca pudding vanilla or chocolate ice cream *Do not use any pastry, doughnuts, ice cream containing fruits and nuts*
2 Jelly and sugar in small amounts *Do not use marmalade or jam*
3 Seasonings—Salt *Do not use pepper, spices, catsup, mayonnaise, horseradish, mustard, vinegar*
4 Beverages—Weak cocoa Postum, Sanka Kaffee Hag *Do not use coffee, tea, beer, alcohol, carbonated beverages*

*Do not use popcorn, candy bars, nuts or potato chips*

Feeding Schedule Bland Diet No 3

8 A M
½ cup of orange juice
1 egg
2 slices of toast or ½ cup of strained cereal
½ cup of cocoa or milk

10 A M
1 cup of milk
1 2 slices of toast

Noon
2 ounces of ground meat
1 small serving of mashed potatoes
1 small serving of strained vegetables
1 slice of toast with butter or margarine
¾ cup of milk

3 P M
Milkshake chocolate or vanilla or milk

6 P M
1 cup of cream soup
1 sandwich (2 slices of toast 1 slice of mild American cheese, butter or margarine)
1 custard

9 P M
Cereal with banana and milk

General Instructions

1 Eat not more than 16 ounces of food or liquid 6 times a day Eat at regular times
2 Any allowed food may be taken at a meal time in combination with milk
3 Eat slowly and chew food thoroughly
4 Cook vegetables in clear salted water Cook until tender Avoid overcooking
5 The best methods for cooking meat and fish are boiling baking and broiling Fish should be flaked and boned
6 Four tablespoonfuls of cottage cheese or two eggs may be substituted for meat noon or night
7 Avoid highly seasoned foods fried foods and foods not listed here
8 Avoid foods which are extremely hot or cold

**Table 94 Bland Diet No 4**

This diet consists of bland nonirritating foods to be taken in three small meals with milk or milk containing foods between meals and at bedtime

Foods Allowed

Soup
Homemade cream soup made from allowed vegetables *Do not use canned soups or meat broths*

Meat Poultry Fish
Tender or ground beef lamb mutton veal liver heart sweetbreads chicken or turkey
Crisp bacon
White nonfatty fish boned and flaked
Rabbit squirrel quail
Meat poultry and fish must be baked boiled or broiled *Do not include smoked or processed meats such as sausage ham, bologna cured pork frankfurters potted meats, tuna fish duck*

Potatoes
White potatoes mashed boiled steamed baked scalloped creamed
Strained sweet potatoes

Vegetables
Beets asparagus carrots winter squash—canned or cooked in clear salted water
Peas spinach summer squash—cooked and strained
Lettuce finely chopped
*Do not use any raw vegetables dried beans and dried peas broccoli cabbage onion peppers radishes cucumbers corn okra commercial tomato paste*

Vitamin C
Strained orange grapefruit or tomato juice—fresh canned or frozen

Eggs
Baked boiled poached shirred or scrambled in the top of a double boiler *No fried eggs*

Fats
Margarine butter other mild fats and oils Use as a spread or for seasoning in moderation

Milk Cream
Sweet milk buttermilk chocolate milk evaporated milk milk beverages

Cheese
Mild American cream or cottage cheese Mild American cheese may be used in sauce for toast and to combine with macaroni spaghetti or noodles *Do not use sharp flavored or spiced cheese*

Bread and Cereals

Bread

White or fine grain wheat Swedish rye, Zwiebach, soda crackers or Hollan Rusk *Do not use hot breads, rolls, biscuits, cornbread, whole wheat or bra bread*

Cereals

Strained oatmeal and pettijohns ralstons cream of wheat, farina cream of ric *Do not use fibrous cereals, such as all bran, shredded wheat, wheatena, grapenut*
Cornflakes, Rice Krispies puffed rice
Spaghetti, rice, macaroni, noodles, grits

Fruits

Applesauce, baked apples, apricots peaches pears royal anne cherries—cooked o canned without skins
Ripe bananas
Plums, prunes—cooked and strained
*Avoid all raw fruits, except bananas, and fruits with skins and seeds such as berrie of all kinds*

Miscellaneous

1 Desserts—Plain custard, cornstarch pudding rice and tapioca pudding plain cake plain cookies vanilla or chocolate ice cream *Do not use any pastry, doughnut ice cream containing fruits and nuts*
2 Sweets—Sugar, honey, clear jelly, hard candy *Do not use marmalade or jam candy bars*
3 Seasonings—Salt *Do not use pepper, spices, catsup, mayonnaise, horseradish mustard, vinegar*
4 Beverages—Weak cocoa, Postum Sanka Kaffee Hag, pineapple juice, prune juice *Do not use coffee, tea, beer, alcohol, carbonated beverages*

*Do not use popcorn, nuts or potato chips*

Example of Schedule

8 A M ½ cup of orange grapefruit or tomato juice
1 egg
Toast with butter or margarine
Strained cereal if desired
Milk or cocoa

10 A M 1 glass of milk or milkshake, chocolate or vanilla

Noon Ground beef pattie
Mashed potatoes
Cooked carrots
Bread with butter or margarine
Milk
Custard

3 P M 1 glass of milk or milkshake, chocolate or vanilla

6 P M Homemade cream soup
Sandwich
Milk
Canned peaches

9 P M Cereal with banana and milk

General Instructions

1 Eat three small meals a day plus milk, milk beverage or milk dessert between meals and at bedtime Eat at regular times

2 Any allowed food may be taken at a meal time in combination with milk

3 Eat slowly and chew food thoroughly

4 Cook vegetables in clear, salted water Cook until tender. Avoid overcooking

5 The best methods for cooking meat and fish are boiling baking and broiling Fish should be flaked and boned

6 Four tablespoonfuls of cottage cheese or two eggs may be substituted for meat noon or night

7 Avoid highly seasoned foods fried foods and foods not listed here

8 Avoid foods which are extremely hot or cold

*Ambulatory treatment* is regarded by many physicians as entirely adequate Crohn[16] writes

Ambulatory treatment suffices in the large majority of cases In fact, the arduous necessities of today often make it imperative that a man be maintained as a functioning member of his family and of the community Where complications exist or threaten the course must be modified and bed rest insisted upon, otherwise the ambulatory treatment gives good results It is better to allow a man with responsibilities and anxieties a moderate control of his affairs than to keep him in bed fretful and restless and anxious

A similar opinion is expressed by Alvarez[24] who in the treatment of the patient with duodenal ulcer permits him to remain at work and advises as the basis of treatment three good meals daily with between feedings at stated intervals The food for the meals is chosen from Alvarez' "smooth diet list For the between feedings a mixture containing a quart of milk, two eggs and perhaps a half pint of cream is placed in a thermos bottle which the patient takes with him to work If milk is not well borne, thin cereal gruels may be substituted Robinson's Scotch groats and Robinson's barley flour are both good Assuming that the patient eats three good meals daily, at 7 30 A M, noon and 6 P M, he then takes between meals at 10 A M, and at 2, 4, 8 and 10 P M a glassful (6 ounces) of the milk and egg mixture Another glassful may be taken if he awakens during the night If this mixture is not available, a milk shake or malted milk at the soda fountain may be substituted

For the patient whose pain is likely to recur within a short time Alvarez advises that a different schedule be substituted and that the mixture be taken at shorter intervals He feels, however, that such a severe condition as a rule demands surgical treatment

The patient is asked to do as little hard work as possible and is told to refrain especially from lifting gardening the daily dozen and even golf Walking is the only exercise encouraged

In addition to the milk and eggs the smooth diet outlined by Alvarez permits the following orange juice grapefruit (avoid the fiber) coffee in moderation chocolate cocoa or tea, white bread and butter toast or zwieback and smooth mush, such as farina Cream of Wheat corn meal or strained rolled oats rice potatoes purées of peas beans or lentils banana baked in the skin, broths bouillon cream soups, chowder small portions of meat, fish oysters chicken or squab simple puddings, such as custards ice cream or Jello plain cake, and canned or stewed fruit

For *severe intractable ulcer* Winkelstein[25] devised a continuous *intragastric drip therapy* designed to neutralize the gastric contents

between meals and at night At first milk was used to which was added *sodium bicarbonate 4 gm to the quart* but more recently this author and his associates have given preference to aluminum gel The phosphate is preferred to the hydroxide because it is less viscid and less constipating The gel diluted with 4 volumes of water is placed in a gravity apparatus specially designed for the increased viscidity of the contents, and a soft latex tube, such as was originally used by Woldman for nasogastric instillation, is passed through the patient s mouth into the stomach The fluid is permitted to flow at the rate of 15 to 20 *drops per minute* The *patient* receives three liberal meals daily and atropine with mild sedatives One hour after each meal the drip is started and it is continued until one hour before the next meal even while the patient is asleep Certain obvious difficulties will be avoided if sedatives such as phenobarbital are liberally used and if the patient has become accustomed to the tube through previous fractional studies

**Recurrences** The cure of peptic ulcer by means of rest and an appropriate diet can be accomplished in more than 90 per cent of cases To prevent recurrences however, is infinitely more difficult The patient seldom stays cured While reporting that 90 per cent of private patients become free from symptoms after careful dietetic management Sandweiss states that of 155 patients treated (medically and surgically) and observed for longer than five years only five (3 per cent) remained symptom free Patients are prone too soon to regard themselves entirely well and to violate the rules of diet As a part of his instructions the physician should always warn against carelessness in this respect While *no cause for the recurrences could be found in many of the cases studied* by Emery and Monroe[26] these clinicians were impressed by the frequency with which three factors—fatigue emotion and infection—were responsible Infections of the upper respiratory tract are believed to be particularly harmful[27] Crohn believes that cigarettes are responsible for many recurrences and states that in any case in which the ulcer is rebellious to treatment nicotinism should be suspected He regards cigars and pipes as less objectionable but states that in any case the use of *tobacco should be kept to a minimum Other apparently* trivial circumstances can precipitate a recurrence—violent exercise a passing infection or nervous anxiety Because of the influence of the emotions as well as the necessity for incessant care Crohn remarks *that while the* physician can cure the ulcer the permanence of the result lies with the patient The majority of secondary ulcerations according to Rivers and Gardner[28] tend to penetrate deeply and therefore produce symptoms which cause more pain at night are less intermittent and are less easily relieved by food and alkali

**Hemorrhage** According to its source hemorrhage varies in its significance and in the treatment demanded That from a relatively recent superficial *erosion in a youthful person differs from the* hemorrhage from an old callous ulcer in a person past fifty years Statistics vary greatly At one extreme are the figures of Hurst who reports a mortality of 1 5 per cent and those of Meulengracht[29] whose *mortality for* 251 patients with bleeding ulcers was less than 1 per cent At the other

extreme are the figures of Allen and Benedict[30] and of Chiesman,[31] who tell of 14 5 and 25 per cent mortality, respectively, and of Gordon Taylor, who reports a 78 per cent mortality for patients who had ex perienced a second large hemorrhage The first and urgent problem is to determine whether the bleeding comes from a superficial ulceration or from a callous, deeply penetrating ulcer The former type, which is represented by the majority of ulcers, should have medical treatment The latter as a rule demands operation in the first twenty four to forty eight hours

Complete rest, both general and alimentary, is essential The patient must be kept in bed, preferably on his back, and should not be per mitted to get up for any purpose, this enforced rest should continue at least two weeks after the hemorrhage has ceased Everything which might raise the blood pressure should be avoided in which are in cluded not only physical effort, but also disturbing emotions, fears should as far as possible be allayed and the patient s equanimity re stored To accomplish this, as well as to stop peristalsis it is usually advisable to give morphine

The wisdom of giving food is debatable In manifest hemorrhage it was formerly customary to give no food for a few days after the bleeding had ceased but this restriction is regarded as inadvisable by most phy sicians who following Lenhartz, feel that it is safe to give raw eggs and milk on the day after the hemorrhage Collins"1 gives ground meat immediately Somewhat startling is the practice of Meulengracht[29] who, with the view of neutralizing gastric acidity and preventing the digestion of the newly formed clot, gives an abundant diet in the form of purées from the first day of hemorrhage, from which he has reported excellent results Dinner, for example, included such articles as broiled chops omelet, fish balls, vegetable soup and stewed apples and apricots of which the patient was encouraged to eat abundantly

A more conservative course is followed by many other clinicians all food should be withheld for three days after the active hemorrhage has ceased only a little water or cracked ice being given by mouth During this time 5 per cent solution of dextrose with vitamins added should almost continuously be given intravenously by the drip method There after hourly feedings of 3 ounces of cold milk should begin, to which on the second day may be added an occasional raw egg and perhaps ground meat After that the two hourly schedule may be instituted Sedatives in the form of barbiturates or morphine should be given in amounts sufficient to allay the patient s anxiety and keep him thor oughly comfortable

With the same object as Meulengracht s and with like success, Wold man[32] resorted by means of a nasal tube and a specially constructed apparatus to a continuous drip of 7 per cent suspension of colloidal aluminum hydroxide This substance besides being an excellent antacid, protects the ulcer by its jelly like coating and being amphoteric, does not produce alkalosis The tube is passed through the nose to the cardiac end of the stomach and the suspension is allowed to flow into the stomach at the rate of 10 drops per minute During the first twenty four

hours of this treatment the patient is given every two hours 2 ounces of a milk and cream mixture After that, cooked cereals custards cream soups, rice and tapioca pudding and gelatin are added This author reports complete recovery of all the twenty one patients with gastro duodenal hemorrhage for whom this treatment was used

*Surgical Measures* Diet, rest and good hygiene consistently observed will relieve the vast majority of duodenal ulcers This is the treatment of choice In ulcer of the stomach the possibility of cancer makes decision difficult, Walters[33] states that 10 per cent of these are malignant Palmer and his associates,[34] writing from the viewpoint of internists state that unless satisfactory evidence can be obtained that the gastric ulcer is benign, operation is indicated They prefer subtotal gastrectomy in such cases because it removes the lesion, whether benign or malignant but in operation for duodenal ulcer they prefer vagotomy with gastroenterostomy The experience of Dragsted and Woodward[34a] lead them to the conclusion that in benign ulcer vagotomy combined with a gastroenterostomy of small size is a relatively safe efficient and practical method of surgical treatment Others[34b] regard resection as the procedure of choice It should be added that certain types of ulcer, whether gastric or duodenal should always be treated surgically those of five or more years duration especially the old calloused ulcer which produces obstruction the ulcer of the elderly patient or the large ulcer which cannot be absolved of the suspicion of being carcinomatous the perforating ulcer, and the ulcer which shows a persistent tendency to bleed Of the several types of operations undertaken, Healy and his associates[35] and Bancroft[35a] believe that gastric resection can be expected to produce significantly superior results even in the elective surgical treatment of intractable duodenal ulcer Lewisohn strongly advises against any operation that leaves the ulcer in situ he insists that the resection should be carried beyond the ulcer

### TUBERCULOSIS OF THE STOMACH

Tuberculosis of the stomach should not be confused with the simple nontuberculous gastritis that accompanies pulmonary tuberculosis The former is rare, while the latter is common Broders[36] reported that in 2500 operations at the Mayo Clinic only one case of gastric tuberculosis was found and Cameron[37] stated that in a series of 2900 autopsies at the University of Michigan, only one such case was encountered It is doubtful whether the disease can be diagnosed clinically It is described as occurring in three forms—as an ulcer which cannot be distinguished clinically from simple peptic ulcer, as tuberculosis gastritis and as hypertrophic thickening of the gastric wall simulating cancer

The *treatment* should be dietetic and hygienic If there is ulceration the diet designed for the patient with peptic ulcer is suitable Otherwise the diet recommended in chronic gastritis should be prescribed The food should be abundantly adequate, and the hygiene should include sufficient rest and sunshine

## SYPHILIS OF THE STOMACH

Syphilis of the stomach may occur any time after invasion by the spirochete becomes general Its existence as an etiologic entity has been questioned, but this was answered by Harris and Morgan[38] when they recovered the organism from the gastric lesion and a regional lymph node Eusterman[39] describes three types of cases (1) The most frequent is the type in which epigastric pain comes on immediately after eating and is made proportionately worse by an increase in the solidity of the food or in the amount of fluid taken The capacity of the stomach becomes greatly reduced, vomiting is frequent, and partial starvation results Dumbbell and high hourglass stomach are seen Sixty three per cent of the cases were of this group (2) The pseudocancer type was represented by 15 per cent of the cases There is a gradual onset, with mild pains a half hour or more after eating relief obtained from food and alkalis is inconstant and incomplete (3) The ulcer type, with typical pain food ease,' was encountered in 22 per cent of the cases Not all physicians will agree with the author when he writes that, regardless of roentgenographic appearances or extent gastric lesions in a syphilitic person should be regarded as syphilitic until proved otherwise

*Treatment* of syphilis of the stomach, according to the kind of lesion demands, in addition to specific drug therapy, the type of diet advised for patients with chronic gastritis or peptic ulcer

## CANCER OF THE STOMACH

Cancer of the stomach can no doubt be precipitated by a number of causes Cramer[40] concludes that it is an error to think in terms of a central problem or of a single cause of cancer, and states that cancer of the stomach may be due to mechanical, chemical or biologic insults to the gastric mucous membrane Mechanical insult and chemical irritation are evidently potent factors, for carcinoma of the stomach seems most likely to develop in a location where such insults are prone to occur or where some other lesion already exists It has been suggested that the stomach is at times the seat of precarcinomatous disturbances which later may lead to true cancer and that the great incidence of this disease in persons who have previously appeared healthy can be explained on the assumption that minor lesions of the stomach are frequently overlooked Among such precarcinomatous" lesions, ulcer is believed to rank first and after this mucous polyp and the atrophic changes in the mucosa which lead to achylia gastrica The last mentioned changes are thought to be the result, at least in the majority of instances of chronic gastritis,[41] and this in turn is believed to initiate the cancer This theory, however, particularly as it relates to ulcer, is by no means universally accepted Today one can be reasonably sure of only one etiologic factor in cancer of the stomach an inherited predisposition

The tragedy of cancer of the stomach as has aptly been said, lies in the paucity of symptoms and the difficulty of recognition during the

early months of its development This was seen in the studies made by MacCarty[42] of the clinical histories of patients with relatively early carcinoma Of like tenor is the report of Boyce,[43] who in his studies of the histories of 400 patients with gastric carcinoma found that there was practically no symptom or sign, initial or terminal which was not represented More recently St John and his associates[44] have demonstrated that early unsuspected carcinoma can be detected in presumably healthy persons through fluoroscopic examination by a skilled observer State and his associates[44a] believe that gastric cancer should be looked for especially in persons of the following groups *(a)* patients over fifty with achlorhydria and hypochlorhydria after administration of histamine, *(b)* patients with pernicious anemia *(c)* relatives of those with gastric cancer, *(d)* patients with surprisingly low hemoglobin levels and *(e)* those with occult blood in the stools *There is no short cut to the early diagnosis of cancer of the stomach* Alertness and eternal vigilance are essential

The *dietary treatment* of cancer of the stomach is undertaken in order to promote the comfort and nourishment of the patient after operation or when for any reason operation is inadvisable This last is true when metastases have formed in the liver or other organs or when advanced age and great weakness make the hazard prohibitive Such hazards should not be permitted to weight the scales too heavily however for against apparently great odds good results are sometimes achieved Theissen,[45] for example, tells of forty patients whose carcinomas were successfully resected even though the preoperative roentgenologic diagnosis suggested that they were inoperable Of 184 patients who underwent resection of the carcinoma, thirty three (18 per cent) were living five or more years later

The dietary regimen should be determined in some measure by the location of the cancer and the nature of the functional disturbance The diet should consist largely of soft foods with no roughage Milk and eggs come first and should be given in relatively large quantities Tender meats preferably in finely divided form, are also suitable Gruels toast, zwieback and preserves should be prescribed Cream and butter are well borne and add to the energy value of the diet other fats should as a rule be avoided Vegetables should be given only in the form of purées The feedings should be small and given at frequent intervals (five or six daily) The bland diets outlined under the discussion of Peptic Ulcer may be adjusted to the varying needs of the patient with gastric malignancy

Anorexia is frequent and for this reason the food should be as appetizing as possible and of sufficient variety Tea coffee and the weaker alcoholic beverages may be of help While it is important to prescribe such foods as will presumably add to the patient s comfort and improve the state of his nutrition it is well to bear in mind that his days are numbered and that his life should not be made miserable by unnecessarily strict dietary regulation His tastes and inclinations unless distinctly harmful, should be given wide play

Lavage should be practiced when there is obstruction leading to stag

nation In this way irritating material is removed, and there results not only relief from pain and discomfort, but also increased secretory activity, with better appetite and digestion Lavage is frequently given in the morning before breakfast, but in order to relieve pain and permit sleep it is sometimes best done at bedtime

## ABNORMALITIES OF SECRETORY ACTIVITY

**Hyperchlorhydria** This is not a disease entity It is a clinical syndrome in which there is both gastric hypersecretion and epigastric distress, both must be present to warrant the designation 'hyperchlorhydria' Increased gastric acidity is not incompatible with health and comfort Gastric juice may be secreted normally in much higher concentrations than appear on clinical examination, and the rate of secretion automatically varies to meet changing needs It appears that the excess of acid is neutralized in part by regurgitated bile, but in larger measure by the mucus produced by the gastric mucosa [46]

The existence of a purely functional disturbance without organic basis, manifested by heart burn acid eructations and gastric juice of high acidity is a matter of question Many authors believe that this syndrome is a frequent accompaniment of nervous disturbances, such as vagotonia and emotional imbalance, while others hold that it always represents some organic disease within the abdomen, such as peptic ulcer appendicitis or cholecystitis The consensus today apparently favors the opinion expressed by Moynihan that constantly recurring hyperacidity always means peptic ulcer As a rule, therefore, the patient who suffers from the syndrome of hyperchlorhydria should be given the diet advised for peptic ulcer or that outlined for irritability of the colon

**Gastrosuccorrhea** Gastrosuccorrhea (Reichmann s disease) is a symptom complex which properly belongs with hyperchlorhydria The excessive flow of gastric juice may occur *(a)* continuously, *(b)* only when food is taken (digestive) or *(c)* intermittently It is merely one evidence of disturbance of the vegetative nervous system which disturbance may be referred back to a wide variety of causes, both psychic and physical The intermittent hypersecretion which occurs most frequently in paroxysms is believed to be of purely reflex nervous origin and is attributed not only to ulcer cholecystitis and appendicitis but also to tabes dorsalis brain tumor, multiple sclerosis and other diseases of the central nervous system

Dietary treatment should not be attempted until the cause of these various manifestations of irritative gastric hypersecretion has, if possible been ascertained and corrected Errors in diet, constipation appendicitis or cholecystitis if present, should receive attention In every instance the possibility of ulcer should first be considered, and in many cases, even though a positive diagnosis cannot be made, the patient should receive the diet appropriate for ulcer

**Achlorhydria and Achylia Gastrica** These conditions were distinguished by Cornell[47] as follows

Achlorhydria is a condition in which by the use of the fractional test meal no free HCl is detected in the stomach contents during either the digestive or interdigestive period although combined acid and some degree of peptic activity are found Achylia gastrica is a condition in which when similarly examined neither free nor combined HCl is detected at any period and peptic activity is lacking The latter definition if desired may be rendered more strict by specifying lack of response to histamine and gastrin and inability of the mucosa to secrete neutral red

Because of its clinical relations achlorhydria has in recent years assumed a much wider significance than formerly The problem of its significance is complicated by the fact that this type of gastric deficiency may be experienced by apparently healthy persons with perfect digestion Indeed the widest variations in gastric secretion, from so called hyper secretion to complete achylia, are not incompatible with the best of health It is seldom known in a given case how long the achlorhydria has been present Obviously it may be acquired but it may be inherited more frequently perhaps than is realized There are achlorhydric families in which some of the members, though handicapped by this defect, remain well, while others have pernicious anemia

As the accompaniment of some more ultimate underlying defect achlorhydria is constantly present in pernicious anemia being uninfluenced by treatment or by spontaneous remissions, and is no doubt the most important single clinical feature of this disease It is also found with great frequency in pellagra, sprue and subacute combined sclerosis Achlorhydria and achylia occasionally accompany many other diseases, notably carcinoma, diabetes, syphilis nephritis and cholecystitis and in these instances seem to be merely an expression of the debilitating influence of these diseases The chief interest therefore which this gastric deficiency holds for the clinician is not in the digestive disturbances which may accompany the lack of hydrochloric acid but rather in its clinical significance

Achlorhydria or achylia may also appear as a salient feature of a purely gastric disorder Chronic gastritis is almost always accompanied by depressed secretion, and as the disease progresses and atrophy of the mucosa takes place, true achylia appears

The diet in achylia gastrica should be that which is best suited to the basic disease If the patient has pernicious anemia, the treatment regimen for that disease should be instituted if he has pellagra he should have the diet prescribed for that disease plus liberal amounts of nicotinic acid and thiamine

The diarrhea associated with achylia is not infrequently the expression of an accompanying disease, notably of pernicious anemia or pellagra The administration of dilute hydrochloric acid is often of help

## DISORDERS OF GASTRIC MOTILITY

Motor disturbances of the stomach are always secondary to some more remote cause, and the appropriate diet is that of the underlying disorder The classification used by Boas which recognizes grades of motor insufficiency without attempting to define the cause, seems best Insufficiency I includes those conditions in which the stomach empties

slowly but completely, insufficiency II, those in which complete emptying does not take place Each group embraces a wide variety of diseases

*Gastric atony*, which belongs in the first group, is a fairly well defined clinical complex, but it is in no sense a disease entity In its advanced stages it is easily recognized fluoroscopically by the lack of muscle tone and poor peristole The flaccid, almost inert stomach, with its ineffectual efforts at contraction, which when filled loses its shape and widens out at the bottom like a bag, is typical This condition may be the result of a wide variety of diseases of either intragastric or extragastric origin, among which are chronic gastritis, cholelithiasis, chronic constipation and debilitating diseases, such as pulmonary tuberculosis Or it may be constitutional and merely one phase of general myasthenia

The subjective sensations which accompany gastric atony are dependent in large part on the emotional and nervous imbalance which is a part of the general asthenic state rather than on the motor insufficiency itself Hence treatment should be directed to the patient as a whole rather than to his stomach alone It should look not only to the protection of the stomach, but also to improvement in morale, stamina and general muscle tone and to the relief of possible underlying disorders

Certain general rules are applicable to the dietary regulation of practically all forms of gastric atony Milk is the best food it should be prescribed in large amount, from 1 to 2 quarts daily, and should be given in small quantities at frequent intervals rather than in large quantities Its nutritive value may be enhanced by the addition of cream, provided it does not cause discomfort or diarrhea Additional fat may be given in the form of butter, but fat in other forms should as a rule be avoided Meats may be given in fairly liberal amounts, but they should be tender and should preferably be served in finely divided form Oysters are good Cereals with cream and eggs cooked in any style may also be taken in abundance Bread should be toasted and should be chewed thoroughly, hot breads and pastries should be avoided

Vegetables should be given largely in puréed form, since bulky foods are to be avoided Stewed fruits in small quantities and fruit juices may be given Large quantities of fluids should be avoided and for this reason soups are considered undesirable The meals should be small and frequent and the food should be well masticated

A certain amount of individualization is essential, and it is often necessary to change the dietary regimen to meet the vagaries of the patient At the same time, emphasis should be laid on the danger of acceding to unreasonable whims and phobias

Unfortunately, the diet just advised favors constipation a condition which often accompanies gastric atony, and corrective measures other than dietary must be used Good hygiene and attention to the general rules recommended for the treatment of constipation will be of help Cascara and other laxatives may be used cautiously, but my decided preference is for plain agar in relatively large amounts If this substance, however, is difficult to obtain, one of the preparations made from psyllium seed may be used

Lavage is sometimes advisable, particularly in cases of the more ad

vanced grades of atony and when chronic gastritis is present It is probably unnecessary in the cases of milder involvement

*Motor insufficiency of the second grade* is the result of stenosis, usually of the pylorus, which may be due in turn to scar formation, to a manifest ulcer, to pylorospasm from an erosion or other reflex cause, to adhesions from perigastritis or cholecystitis, to carcinoma, to syphilitic infiltration or to linitis plastica with hypertrophic stenosis The inability of the stomach to empty leads to stagnation of its contents and gradually to greater dilatation The resulting gastrectasis may be of such extreme grade that the gastric cavity is three or four times larger than normal Fermentation of the stagnating contents follows, with abdominal distress, vomiting and emaciation

**Table 95 Menus for Patients with Gastric Atony***

| | |
|---|---|
| First Day | |
| 6 A M | 1 glass of orange juice |
| 8 A M | Farina with cream and sugar |
| 10 A M | 1 coddled egg with 1 slice of toast and butter |
| 12 M | Scraped beef patty toast milk |
| 2 P M | Baked apple, free from peel and core cream |
| 4 P M | Milk and egg shake |
| 6 P M | 2 egg omelet zwieback a little buttermilk |
| 8 P M | Stewed prunes with cream, toast milk |
| Second Day | |
| 6 A M | Juice of ½ large grapefruit |
| 8 A M | Well cooked oatmeal with cream and sugar soft boiled egg toast milk |
| 10 A M | Apple sauce, 1 glass of milk |
| 12 M | Panned oysters on toast milk |
| 2 P M | Scrambled egg zwieback, milk |
| 4 P M | Equal parts of orange juice and milk shaken up with 1 egg |
| 6 P M | Milk toast 1 glass of milk |
| 8 P M | Prune or peach whip 2 crackers milk |
| Third Day | |
| 6 A M | ⅔ glass of mixed fruit juice |
| 8 A M | Cream of Wheat with a little butter poached egg toast milk |
| 10 A M | Shirred egg zwieback milk |
| 12 M | Broiled tenderloin steak toast milk |
| 2 P M | Rice cooked in milk cream 1 glass of milk |
| 4 P M | 2 soft boiled eggs toast orange juice |
| 6 P M | Scrambled egg with brains toast milk apple sauce |
| 8 P M | Milk and egg shake |
| Fourth day | |
| 6 A M | 1 glass of orange juice |
| 8 A M | Cooked cereal with cream and sugar, egg poached in milk toast milk |
| 10 A M | Baked apple with cream milk |
| 12 M | 2 egg omelet with rice toast milk |
| 2 P M | Scraped beef patty toast milk |
| 4 P M | Milk and orange juice whipped up with 1 egg and 1 teaspoonful of sugar |
| 6 P M | Creamed oysters on toast milk prune whip |
| 8 P M | Cream of Wheat toast milk |
| Fifth Day | |
| 6 A M | ½ glass of grapefruit juice |
| 8 A M | Farina with cream and sugar milk toast 1 glass of milk |
| 10 A M | 2 scrambled eggs apple sauce, toast |

| | |
|---|---|
| 12 M | Very tender roast leg of lamb no gravy rice with butter toast 1 glass of orange juice |
| 2 P M | Soft boiled egg toast milk |
| 4 P M | Apple sauce with cream toast milk |
| 6 P M | Creamed toast prune sauce milk |
| 8 P M | Cream of Wheat with butter stewed fruit toast milk |

* Feedings may begin at 8 A M and end at 10 P M if desired

The treatment of pyloric stenosis and gastrectasis is that of the under lying disease most often it is surgical Sippy, however reported highly satisfactory results from the use of his treatment for ulcer even after the development of pronounced and long standing pyloric obstruction When the obstruction is due to causes other than ulcer the diet should in general be that advised for gastric atony Particular care should be taken to prescribe only the most nourishing foods and those which are nonstimulating and nonirritating Milk eggs cereals with cream milk toast mashed potatoes lean fish and finely chopped tender lean meats are suitable Emphasis should be laid on the necessity for frequent feedings which are small in quantity In extreme cases dextrose solution should be given intravenously

Lavage accomplishes a great deal for the patient s comfort and sense of well being The stomach should be washed out daily, either before breakfast or at bedtime It is sometimes of advantage to add boric acid to the water in the proportion of a teaspoonful to the liter Both lavage and dietary regulation, however are in the vast majority of cases mere subordinate measures which are useful in preparing the patient for operation

*Acute dilatation* of the stomach with its distressingly ominous train of symptoms may appear in the course of an infectious disease after an abdominal operation or after gross dietary indiscretions Continuous gastric lavage should be performed and no food should be permitted Fluid in the form of dextrose solution should be given intravenously

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# 21

## *Diseases of the Digestive Organs* (Continued)

### THE GASTROINTESTINAL NEUROSES

#### *Nervous Indigestion*

Nervous indigestion is a functional disorder of the gastrointestinal tract, the manifestations of which are many and varied, these may be the expression of chemical, motor or purely sensory disturbances Only too often nervous indigestion is due merely to a "disorder of personality" If for no other reason than the length of the gastrointestinal tract, as Menninger remarks, disorders of this sort constitute the largest single group of malfunctions in medicine

In its origin this disorder can be regarded as merely one phase of a larger symptom complex, the psychoneurosis Anything which upsets a person's nervous balance may be an exciting factor, whether mental strain, overwork, grief, debilitating illness or chronic intoxication, but nervous indigestion seldom if ever occurs, no matter what the provocation, in a person with a fundamentally stable nervous system It always indicates emotional imbalance

The description by Wilbur and Washburn[1] of patients with nervous vomiting portrays with almost equal fidelity those who complain of other forms of gastrointestinal disturbance of nervous origin

> The typical picture is presented by a relatively young woman with signs of nervous emotional cardiovascular instability who without much apparent reason or associated abdominal distress or nausea has for months or years vomited within an hour after meals without much appreciable effect on her general health Other features which may be quite helpful in diagnosis are the onset of vomiting or its recurrence during periods of nervous stress or strain or as a result of fatigue the characteristic ability of the patient

Such inconsistencies are peculiarly characteristic of nervous indigestion

To the observant physician, patients with nervous dyspepsia as a rule exhibit recognizable stigmas which indicate that the distress is of psychic or emotional origin Evidences of emotional imbalance are common Then, too, the variability of the symptoms, their independence of the digestive processes, their bizarre nature and the fact that they are often absent when the patient is dining out or is otherwise entertained are all suggestive Care must be taken in the differential diagnosis

to exclude a wide variety of diseases, among which are food idiosyncrasy, allergy, migraine, pregnancy, ulcer and carcinoma and such extragastric diseases as cholecystitis and appendicitis Until these have been excluded a diagnosis of nervous indigestion should not be made

A thorough examination is essential There are two good reasons for this first, such an examination is necessary for proper diagnosis, and, second, without it the physician cannot make himself sufficiently secure in the patient's confidence to carry out the necessary psychotherapy To tell a nervous patient offhand that his troubles are imaginary and that he must forget them accomplishes nothing The physician must first convince the patient by a searching inquiry into his condition that he is genuinely interested and that he knows what he is about Otherwise treatment will be of little avail

**Treatment.** 'Treatment by explanation' is the proper method In the beginning, however, as a noted psychiatrist[2] has remarked, it is not the physician's place to say anything, he must listen Having listened at length and having given every consideration to the complaints, the physician gains the patient's confidence and then explains the true nature of the disorder If, as is often the case, the origin of the current symptoms can be traced to some earlier emotional disturbance or some other circumstance, this connection should be fully elaborated The patient should tactfully be taught accurately to see himself and his troubles as the physician sees them His phobia must be combated He must be induced to eat those articles which he erroneously believes to be harmful and in this way to learn that his stomach is able, if given a fair chance, to perform its work properly The physician must have understanding tact, patience and firmness and, above all, must remember that he is treating the patient, not the patient's stomach

*Dietary regulation* when accompanied by restriction of food is likely to be harmful For psychologic reason as well as to insure adequate nourishment, the patient must be given a full, well balanced diet without too much effort at selection Obviously this does not apply to foods toward which he has an idiosyncrasy or to which he is allergic, these must be eliminated Nor does it apply rigidly in the patient who has an abnormally sensitive digestive tract and who does not tolerate roughage Such a patient should not be given bran or whole wheat or large quantities of rough vegetables For a time puréed vegetables are advisable, but in imposing such restrictions care must be taken lest the psychologic effects defeat the chief purpose of treatment It is often a good maneuver if the patient is in a hospital to keep him during his first two or three days of treatment on an all milk regimen and then suddenly, when he is hungry, to give him a large, well balanced meal and to insist that he take all of it This preparatory semistarvation often places him in the proper frame of mind for what is to come In other cases, the full diet may be begun immediately

Two rules for the guidance of the physician are pertinent *(a)* The directions must be explicit, especially in the beginning, not general or vague and *(b)* the treatment must be individual The patient should be told that he is being given a general, well balanced diet such as any

normal man should eat, but its arrangement should not be left to his choosing, he is too likely to vacillate and doubt He should be told just what to eat, so much milk, so much meat, so much bread and butter and so much fruit, green vegetables and other foods The food should be prescribed with due consideration for what the market affords and with some consideration (but not too much) for the patient's preference If he is constipated, this must be taken into consideration At first a few daily menus may be given in detail In order, however, that the patient may realize that he is being treated as an individual rather than merely as one of a group, these instructions must be individual, while preferably written or typewritten, they should never be in the form of a printed slip

*All handicaps, such as carious teeth, should be removed* The patient must know how to masticate properly and must know the meaning of good hygiene Physical exercise carried out regularly and according to prescription, and hydrotherapy (a cold morning plunge) are helpful adjuvants Medicines as a rule should be avoided, but occasionally a little phenobarbital will so lessen nervous irritability as to enable the patient to regain confidence in his stomach

The following specimen menus suitable in cases of nervous indigestion provide merely a well balanced diet such as any normal person should take

**Table 96 Menus Suitable for Patients with Nervous Indigestion**

I

Breakfast
- Sliced orange
- Cooked cereal with cream and sugar
- Poached egg on toast
- *Tea or coffee cream and sugar*

Midmorning
- Orange or grape juice

*Dinner*
- Lamb fricassee 2 tablespoonfuls of rice
- Average helping of green lima beans
- Salad tomato lettuce dressing
- 1 corn *muffin butter*
- Prune whip with whipped cream
- Sweet milk or buttermilk

Supper

- Pineapple sherbet
- Milk

Bedtime
- Figs or prunes

II
- ½ glass of grapefruit juice
- Shredded Wheat biscuit cream and sugar
- Soft boiled egg
- Toasted muffins and butter
- Coffee or tea sugar and cream

Midmorning
    Sweet apple juice or other fruit juice

Dinner
    Medium sized helping of broiled fish lemon
    Small baked potato butter
    Greens of any kind
    Salad apple celery shredded carrot mayonnaise

Midafternoon
    1 glass of buttermilk

Supper
    Egg omelet broiled tomato
    Average helping of hominy grits butter
    Buttered asparagus on toast
    Canned apricots with arrowroot crackers
    1 slice of toast
    1 glass of sweet milk

Bedtime
    Prune juice

III

Breakfast
    Fresh fruit in season
    Creamed toast with crisp bacon
    Toasted French roll butter jelly
    Coffee or tea sugar and cream

Midmorning
    Juice of 1 orange

Dinner
    Broiled steak
    Small baked potato
    [illegible]

    Milk

Midafternoon
    1 glass of tomato juice

Supper
    Minced chicken on toast
    Steamed rice butter
    Asparagus salad with mayonnaise
    1 popover butter
    Baked apple with cream
    Milk

Bedtime
    3 or 4 figs

IV

Breakfast
    1 glass of orange juice
    Cold cereal sugar rich milk
    1 shirred egg
    2 whole wheat muffins butter preserves or honey
    Coffee or tea cream and sugar

Midmorning
    Prune juice

Dinner
- Average helping of roast beef
- Stuffed potato butter
- Buttered carrots
- *Frozen fruit* salad cream dressing
- 2 small rolls or corn muffins butter
- Milk

Midafternoon
- Lemonade

Supper
- Creamed oysters on toast
- Average helping of buttered squash
- Shredded carrot and celery salad mayonnaise
- Baked apple with cream
- 1 slice of toast with butter
- Milk

Bedtime
- Fruit juice

V

Breakfast
- ⅔ glass of tomato juice
- 2 slices of French toast with 1 egg
- 2 slices of crisp bacon jelly
- Tea or coffee cream and sugar

Midmorning
- Fresh fruit

Dinner
- Medium sized helping of roast or broiled chicken
- Creamed noodles
- Scalloped eggplant
- Stuffed tomato on lettuce mayonnaise
- Average helping of baked custard
- 2 slices of whole wheat bread butter
- *1 glass of milk*

Midafternoon
- 1 cup of hot weak tea butter wafers

Supper
- Cream of pea soup crackers
- Broiled tomatoes cheese sauce (2 tablespoonfuls of white sauce with 1 tablespoonful of cheese)
- *Apple tapioca pudding*
- 1 muffin or bread butter
- Milk

Bedtime
- Fruit of any kind

VI

Breakfast
- ½ grapefruit
- Hot cereal cream and sugar
- 1 egg omelet
- 1 whole wheat raisin muffin
- Coffee or tea with sugar and cream

Dinner
- Beef stew with vegetables (potatoes carrots on ons)
- Salad ⅔ cup of spinach drained molded and chilled 1 hard boiled egg 1 slice of lemon 1 tablespoonful of mayonnaise
- 1 corn muffin
- Canned apricots or peaches 1 slice of angel cake
- 1 glass of milk

Supper
- Scalloped eggs en casserole
- Buttered asparagus on toast
- Creamed carrots
- 1 baked banana in skin
- 1 slice of toast
- Milk

Bedtime
- 3 or 4 figs

VII

Breakfast
- Fresh fruit in season or 1 sliced orange
- Grape Nuts with cream
- 1 egg scrambled with tomato
- 1 muffin butter
- Coffee or tea

Dinner
- Lamb chops with jelly
- Mashed potato
- English peas
- 1 roll butter
- Tomato salad with mayonnaise
- Lemon or pineapple Jello with whipped crea n

Supper
- Panned oysters on toast
- Baked sq iash
- Pineapple or pear salad with cottage cheese cream dress ng
- 1 or 2 pieces of zwieback butter
- 1 glass of milk

Bedtime
- Fruit

## Flatulence

Flatulence is one of the most frequent abdominal disorders The swallowing of atmospheric air may play a role sometimes a major one but in many instances other causes are operative The most frequent of these is the excessive production of gas and its deficient expulsion or absorption Bacterial activity may produce flatulence this occurs often in colitis and less frequently in constipation Loss of muscle tone from various neurogenic or myotoxic causes probably accounts for the abdominal distention seen after operations and in many other illnesses to which factor may be added the sudden secretion of blood gases chiefly nitrogen into a partially paralyzed intestinal tract This is probably the cause of the alarmingly sudden distention sometimes en countered during an acute illness

For the present take no other food This diet should be taken in small feedings six times daily It is best to take three regular meals at regular times that is breakfast lunch and dinner and in addition small feedings in the middle of the morning in the middle of the afternoon and at bedtime

In addition to the foods mentioned you should take twice weekly a liberal helping of liver

This diet is lacking in green vegetables and therefore cannot be continued indefinitely After one week there should be added two possibly three helpings daily of puréed vegetables (freed of all woody particles and mashed through a sieve) The vegetables and fruits commercially canned in this form for infants are entirely satisfactory

All cathartics must as quickly as possible be stopped The difficulty in accomplishing this in a satisfactory manner is increased by the withdrawal of vegetables and fruits from the diet, but this can be compensated for by the use of agar In the beginning it may be necessary (especially if the patient has little faith) to give a small quantity of cascara at night, but this should be discontinued as soon as possible Agar is excellent in these cases, since it gives bulk to the intestinal contents and lacks the irritating effect of the rough foods It can with impunity be given in any quantity, two or three heaping teaspoonfuls three times daily, taken dry at the end of the meal are usually sufficient There is some skill in the taking of agar which can be acquired with experience, it should be taken dry in the mouth, a teaspoonful at a time, and after thorough admixture with a little water, swallowed with the addition of another drink of water If agar cannot be obtained one of the psyllium seed preparations may be used

### Mucous Colitis (Spastic Colon, Neurogenic Mucous Colitis)

According to present day conception, this disease is not a true colitis nor is it a disorder of the intestine alone It is regarded as a disorder primarily of the nervous system the chief manifestations of which are in the intestinal tract It is most often encountered in neurotic persons who show additional evidences of nervous instability True there is usually a history of long standing constipation and drastic purgation which train of events, with the resulting injury to the intestinal mucosa was looked upon by Von Noorden as the cause of the disease It is apparent, however, that the underlying intestinal disorder is not in the mucosa but rather in the motor mechanism of the intestine and that it expresses an instability of neuromuscular control This in the last analysis is dependent apparently upon disturbances in the vegetative nervous system Indeed it is not improbable that mucous colitis and irritable colon represent in different degrees the same type of disturbance and that the latter, if long continued, may even lead to the organic changes seen in ulcerative colitis

Mucous colitis derives its name from the fact that it is characterized by the passage of large quantities of mucus which at times may take on a firm consistency and so closely assume the shape of the intestines as to suggest the passage of a part of the intestinal wall The attacks of abdominal pain which frequently precede the evacuation of mucus are probably due to efforts at its dislodgment, or they may represent

spastic contractions of the intestine arising from other causes Other types of pain, sometimes mild and vague, sometimes severe and localized, are also encountered The roentgenographic evidences of mucous colitis are fairly characteristic They are similar to those produced by the irritable colon, but the redundancy of the large intestine, its lack of haustra and its stringy appearance are all more marked Bockus and his associates believe that the smooth, glistening appearance of the rectum and sigmoid flexure through the sigmoidoscope is also characteristic

Treatment In planning treatment, attention should be addressed first to the patient himself, his constitutional predisposition, his heredity, his background and above all his stamina and ability to meet the problems of life To inculcate a certain degree of equanimity and to teach the patient to acquire emotional stability are more important than to regulate the diet

There are two opposed views as to the dietary treatment of this disease European physicians prescribe an abundant diet, which contains large quantities of green vegetables, bran, fruit and other roughage, such as is best suited to the relief of constipation On the other hand, many American clinicians advise a bland, nonirritating diet, which consists largely of milk, cereals eggs, purées tender meats, potatoes and white bread This difference of opinion as to diet may be due not only to differing conceptions of the nature of the disease but also to the fact that several different pathologic processes are perhaps grouped together under the term mucous colitis The rough diet may be of value in certain types, but in the experience of American physicians the smooth diet is infinitely better This type of diet is outlined in the section on Irritable Colon

The problem of correcting the constipation in this disease is the same as that discussed with irritable colon and the management should be the same Cathartics must be withdrawn and as a rule agar in large amounts substituted Its use should be continued indefinitely If it is impossible to obtain agar one of the psyllium seed preparations may be substituted

## THE DIARRHEAS

The chief organ of digestion is not the stomach it is the small intestine The stomach merely prepares the food for reception by the intestine, and it is here that digestion and absorption take place Important as is this section of the bowel, knowledge of the disorders which affect it are meager this is particularly true of the most common of these disorders diarrhea

Diarrhea is the passage of frequent stools of lessened consistency The number of stools may vary from three or four in twenty four hours to one every few minutes the consistency may vary from that of water to a semisolid state The dejecta assume these characteristics because they are hurried through the intestinal canal with inadequate absorption or with the abnormal exudation of water

Diarrhea may be classified as functional and organic Kantor[8] enumerated the functional diarrheas as follows simple or environmental which may occur in any normal person whose intestine is exposed to an irritant, anaphylactic or allergic, gastrogenous, the result as a rule of achlorhydria, putrefactive and fermentative, associated probably with enteritis caused by a 'wall infection, endocrine, due to hyperactivity of the thyroid gland or depressed activity of the adrenal cortex nervous, due to colonic instability, compensatory, seen in association with uremia cutaneous burns and the breakdown of senility, and nutritive as in the diarrheas of sprue (idiopathic steatorrhea) and pellagra

*Among the organic diarrheas are those due to bacterial and protozoan invasion and to external poisons as well as to diseases of unknown nature such as chronic ulcerative colitis and regional ileitis*

The *recognition* of the nature of the diarrhea is accomplished not alone through an examination of the stool, but also by means of a carefully taken, well interpreted history and the other customary methods of examination To facilitate examination of the stools the test diet of Schmidt is still regarded as suitable This diet is given the patient for about three days, occasionally longer, until it is certain that its end products are appearing in the feces It provides 110 gm of protein 105 gm of fat and 200 gm of carbohydrate, giving about 2247 Calories which is sufficient for a patient who is not attempting much work

**Test Diet of Schmidt**

Breakfast 1 pint of milk (or when milk is not well borne 1 liter of cocoa made from 20 gm of cocoa powder 10 gm of sugar 400 gm of water and 100 gm of milk) 50 gm of zwieback

About 10 A M 1 pint of oatmeal gruel made of 40 gm of rolled oats 10 gm of butter 200 gm of milk 300 gm of water and 1 egg with a little salt

Lunch 125 gm of chopped or scraped beef (weighed raw), broiled with 20 gm of butter 250 gm of mashed potatoes

About 4 P M The same as breakfast

Supper (7 P M) The same as at 10 A M (*occasionally a little thinly sliced raw ham is added*)

The character of the stool, its color and odor, the presence of mucus and blood and the presence or absence of undigested food particles all give information of value An exceedingly foul smelling stool alkaline in reaction and dark brown indicates proteolytic decomposition while a light yellow specimen which is acid in reaction and shows bubbles of gas indicates abnormal fermentative activity the two are not always easy to distinguish Bulky grayish stools containing a great deal of fat are characteristic of pancreatic disease A portion of the feces should be spread on a plate for careful inspection After being thoroughly rubbed up with water, it is examined for connective tissue fragments and pieces of muscle Sago like granules of potato indicate poor digestion of starch Particles of connective tissue indicate a disturbance of gastric digestion and the presence of muscle fibers with recognizable cross striping suggests failure of the pancreatic ferments The presence of mucus in recognizable amounts indicates some inflammatory reaction

Pus and blood tell of more deeply seated inflammatory disturbances As a rule little can be told from the number and the character of the microorganisms present

### Diarrheas of Functional Origin

The simple diarrheas usually correct themselves after the cause has been removed, but sometimes to accomplish this a purgative is necessary Anaphylactic diarrheas and those due to food idiosyncrasy are treated by elimination of the offending foods Putrefactive diarrhea, after the initial dose of castor oil, demands a diet high in carbohydrate and low in protein The fermentative diarrheas, on the other hand, require liberal amounts of protein, with restriction of carbohydrate The other diarrheas that have been mentioned demand treatment of the underlying disease The diarrheas of organic origin will be given special consideration

*Dietary regulation,* whatever the type of diarrhea, should conform, as suggested by Brown,[7] to certain fundamental rules (1) The food must be sufficient in amount This does not apply to the well nourished person with nervous diarrhea, but it does apply to all others, notably those who are thin and depleted, it is obvious that if a patient loses a large part of his food in the feces, his requirement is proportionately greater (2) The food must be adequate in quality and should supply all nutritive essentials (3) The palatability and attractiveness of the food must have consideration otherwise the digestive organs will not work to best advantage

No single dietary regimen is suitable in every case indeed the same diet is not necessarily suitable at all times for the same patient Since poor chymification of the food is probably an important factor, no article should be given which cannot be thoroughly and easily chymified This means that salads and leafy vegetables should be avoided and that only those vegetables should be given which can be thoroughly cooked and prepared in puréed form For the same reason, care should be taken not to overload the stomach, the meals should not be large

If the feces show the presence of undigested starch, more albumin and less starchy food should be given In such cases eggs meat soups, finely ground meat, vegetable purées and milk with a little toast or zwieback should be the chief articles of diet A limited amount of carbohydrate in the form of sweets such as honey and preserved fruits is often well borne If, on the other hand putrefactive processes predominate or if the feces show the presence of muscle fibers or connective tissue in considerable amount meats should as far as possible be removed from the diet The food should then consist largely of the simpler carbohydrates with very little protein gruels with cream, zwieback, toast, rice, mashed potatoes, bread and butter with orange marmalade and other preserves and milk

Many clinicians object to the use of milk in intestinal disturbances This no doubt holds good for infants but in my experience with adults milk is as a rule well borne in cases of diarrhea It is best given with

other foods, for instance, one or two glasses at a meal *Acidophilus* milk sometimes corrects the disturbance by changing the intestinal flora It should be given in amounts of 1 to 2 quarts daily, with the addition perhaps of milk sugar Fats as a rule are not well borne and therefore should be limited in amount They should be taken chiefly in the form of butter, cream, and egg yolk No definite rules however can be laid down, and the physician must be guided as to the allowance of fat by the experience of the individual patient

**Table 97 Menus for Patients with Intestinal Indigestion**

| | |
|---|---|
| I | |
| 8 00 A M | 1 shirred egg 1 slice of toast 1 glass of milk |
| 10 00 A M | 1 cup of cocoa with 1 piece of zwieback |
| 12 30 P M | Cream of pea soup |
| | Tomato omelet (1 egg) 1 slice of toast jelly |
| 3 00 P M | 1 glass of milk 1 slice of toast |
| 6 00 P M | Purée of English peas |
| | 1 poached egg on toast |
| 8 00 P M | 1 glass of milk 2 pieces of zwieback |
| II | |
| 8 00 A M | Coddled egg toast cocoa |
| 10 00 A M | Milk toast honey |
| 12 30 P M | Purée of spinach with egg (½ cup of purée of spinach put into baking cup break into center 1 egg bake in slow oven till soft cooked) |
| | Milk with 1 slice of toast |
| 3 00 P M | Milk and egg shake |
| 6 00 P M | Cream of asparagus soup with croutons |
| | Milk toast (1 piece of toast) 1 cup of cocoa |
| 8 00 P M | 1 cup of beef or chicken broth with 1 dropped egg |
| III | |
| 8 00 A M | Milk toast cocoa |
| 10 00 A M | Milk and egg shake |
| 12 30 P M | 1 cup of broth (4 or 5 vegetables cooked in beef broth and strained out) |
| | Shirred egg toast marmalade |
| 3 00 P M | Milk and egg shake |
| 6 00 P M | ½ cup of purée of lima beans |
| | 1 soft boiled egg zwieback milk |
| 8 00 P M | 1 cup of beef broth with 1 slice of toast |

Pectin is said to be of value in the milder diarrheas It should be given in the form of applesauce in relatively liberal amounts and preferably alone rather than with the regular meals [8]

Vitamin deficiency due to failure of absorption is frequently the cause of long continued diarrhea This has been emphasized with special reference to thiamine by Dann and Cowgill [9] who state that since this vitamin is not stored in sufficient quantities to protect against prolonged deficiency, it is unwise to place reliance upon the patient s previous state of nutrition The appearance of anorexia is especially significant It has been shown[10] that lack of folic acid will precipitate the development of bacillary dysentery in monkeys when the intestinal tract harbors the causative organism

Table 98 Menus for Patients with Fermentative Dyspepsia*

| | |
|---|---|
| I | |
| 8 00 A M | 1 large scraped beef patty<br>1 slice of toast thin and well toasted<br>1 cup of cocoa or milk |
| 10 00 A M | 1 soft boiled egg 1 piece of zwieback |
| 12 30 P M | Very tender rare roast beef<br>Boiled custard *toast milk* |
| 3 00 P M | Corn meal gruel zwieback milk |
| 6 00 P M | Panned oysters on toast<br>Orange Jello milk |
| 8 00 P M | 1 glass of milk zwieback |
| II | |
| 8 00 A M | 2 soft scrambled eggs<br>1 slice of toast cocoa or milk |
| 10 00 A M | Oatmeal gruel with milk |
| 12 30 P M | Very tender broiled steak zwieback milk |
| 3 00 P M | Oyster stew 1 slice of toast |
| 6 00 P M | Broiled fish with egg sauce toast<br>Spanish cream |
| 8 00 P M | Soft boiled egg milk |
| III | |
| 8 00 A M | Panned oysters on toast<br>Cocoa or milk |
| 10 00 A M | Baked custard 1 glass of milk |
| 12 30 P M | Boiled fish with white sauce toast<br>Milk Jello |
| 3 00 P M | Corn meal gruel with milk |
| 6 00 P M | Small broiled beef patty 1 slice of toast<br>Milk cherry Jello |
| 8 00 P M | Oatmeal gruel 1 cup of milk<br>1 glass of milk |

* A small amount of sugar may be used in the desserts

Table 99 Menus for Patients with Intestinal (Putrefactive) Indigestion

| | |
|---|---|
| I | |
| 8 00 A M | Arrowroot or corn meal gruel with cream<br>Zwieback with butter and jelly or honey<br>Cocoa |
| 10 00 A M | Milk toast |
| 12 30 P M | Medium sized baked potato mashed with 1 teaspoonful of butter<br>Zwieback with milk |
| 3 00 P M | Barley gruel with cream 1 slice of toast<br>Milk |
| 6 00 P M | 1 slice of cream toast with yolk of hard boiled egg<br>Cocoa |
| 8 00 P M | Zwieback butter buttermilk with milk sugar |
| II | |
| 8 00 A M | Oatmeal gruel with cream<br>1 egg yolk soft scrambled with 2 teaspoonfuls of cream<br>Toast marmalade cocoa |
| 10 00 A M | 1 glass of buttermillk 1 slice of toast |
| 12 30 P M | Well cooked rice with milk and butter<br>Zwieback honey milk |
| 3 00 P M | Barley gruel 1 glass of milk |
| 6 00 P M | Mashed potato 1 slice of toast marmalade milk |
| 8 00 P M | Corn meal gruel cream 1 piece of zwieback |

III

| | |
|---|---|
| 8 00 A M | Creamed toast with egg yolk cocoa |
| 10 00 A M | Corn meal gruel cream 1 slice of toast |
| 12 30 P M | Baked and mashed potato butter toast milk |
| 3 00 P M | Buttermilk 1 slice of toast marmalade |
| 6 00 P M | Milk toast rice cocoa |
| 8 00 P M | Barley or arrowroot gruel zwieback marmalade milk |

## Diarrheas of Organic Nature

**Acute Enteritis** Acute enteritis which represents an actual inflammation of the bowel may be due to the widest variety of causes It is not always distinguishable from the functional diarrheas since the latter are frequently accompanied by mild degrees of enteritis and may show mucus in the feces The presence of mucus in appreciable amounts, however, can as a rule be taken to indicate outspoken enteritis Anything which irritates the intestinal mucosa whether mechanical or chemical can produce enteritis In the vast majority of instances however, the disease is due to bacterial invasion It may be merely a part of some well characterized infectious disease such as typhoid cholera amebic or bacillary dysentery or tuberculosis it may be due to some recognizable bacterial invasion without a well defined clinical complex, such as comes from contamination of food with the paratyphoid bacillus or the Staphylococcus (see Food Poisoning ) or while of infectious origin it may be due to some unidentified organism It may be due also to vitamin deficiency

In most instances there is inflammation of the entire alimentary tract so that the disease may be regarded as a true gastroenterocolitis The nausea and vomiting which usually occur first probably represent acute gastrititis The great prostration thirst, fever and pains in the muscles are probably dependent on loss of water rather than on so called toxemia

Recognition of acute enteritis is based on the symptoms The watery stools will in the beginning contain undigested food particles but later will contain little more than bacteria water and mucus There are myriads of microorganisms in the stools and except in a few diseases such as amebic dysentery little can be learned from their study Occasionally as in epidemics due to the dysentery bacillus agglutination tests will tell the story

**Table 100 Menus for Patients with Acute Enteritis**

Second and Third Days
Milk every 2 hours

Fourth Fifth and Sixth Days

| | |
|---|---|
| 7 A M | Cream of Wheat with milk |
| 9 A M | Milk toast |
| 11 A M | Strained oatmeal gruel with milk |
| 1 P M | Chicken or beef bouillon with 1 slice of dry toast |
| 3 P M | Strained oatmeal with milk 1 glass of milk |
| 5 P M | Farina 1 glass of milk |
| 7 P M | Corn meal gruel 1 glass of milk |
| 9 P M | Milk |

Seventh to Ninth Day

| | |
|---|---|
| 7 A M | Farina with a little butter 1 glass of milk |
| 9 A M | Coddled egg 1 slice of toast |
| 11 A M | Strained oatmeal with butter 1 glass of milk |
| 1 P M | Small piece of very tender broiled steak ½ slice of toast milk |
| 3 P M | 1 slice of toast butter 1 teaspoonful of jam or jelly |
| 5 P M | Milk toast with soft boiled egg |
| 7 P M | Toast butter marmalade 1 glass of milk |
| 9 P M | Strained oatmeal with butter 1 glass of milk |

Tenth to Twelfth Day

| | |
|---|---|
| 1 P M | Average helping of scraped beef patty toast jelly |
| 3 P M | Cream of Wheat with butter and milk |
| 5 P M | Small helping of creamed fish flakes 1 slice of toast |
| 7 P M | Soft boiled egg 1 piece zwieback |
| 9 P M | Toast marmalade milk |

*Treatment* should as a rule begin with the administration of a laxative such as 1 or 2 tablespoonfuls of castor oil but if there has been profuse diarrhea and the intestine is already cleared of offending material this is unnecessary A sulfonamide or other appropriate drug should be given No food should be given for the first twenty four or perhaps forty eight hours Then simple gruels such as was advised in cases of acute gastritis should be prescribed Milk is usually well borne and in many instances should for a time be the only food Strained oatmeal farina Cream of Wheat milk toast and bouillon to which a little toast has been added may also be given at this time Later an occasional egg and then a little tender meat with toast butter and preserves may be added It may be that milk is not well borne because of its relatively large residue and in such instances lean meat as provided in the low residue diets devised by Alvarez may be given

If the diarrhea is prolonged vitamin deficiency may be superimposed upon the enteritis Puréed vegetables and fruits if well tolerated should be given and in addition food concentrates or the vitamins in pure crystalline form

It is essential in acute enteritis that the patient be kept absolutely at rest in bed Not infrequently tincture of opium or powder of ipecac and opium (Dover s powder) should be given Warm applicaions to the abdomen add to the patient s comfort

**Chronic Ulcerative Colitis** Chronic ulcerative colitis is an inflammatory disease of the large intestine The cause is unknown Bargen isolated a diplococcus which alone or in association with a filtrable virus he believed to be the causative factor but the specificity of this organism is not generally accepted Other organisms notably the *Shigella dysenteriae* have also been brought into causal relationship with this disease but their specificity likewise has been denied Secondary invaders of various types probably give color to the picture Nutritive deficiency apparently plays an important role but this role

III.

8.00 A.M.: Creamed toast with egg yolk; cocoa
10.00 A.M.: Corn meal gruel; cream; 1 slice of toast
12.30 P.M.: Baked and mashed potato; butter; toast; milk
3.00 P.M.: Buttermilk; 1 slice of toast; marmalade
6.00 P.M.: *Milk toast; rice;* cocoa
8:00 P.M.: Barley or arrowroot gruel; zwieback; marmalade; milk

## Diarrheas of Organic Nature

**Acute Enteritis.** Acute enteritis, which represents an actual inflammation of the bowel, may be due to the widest variety of causes. It is not always distinguishable from the functional diarrheas, since the latter are frequently accompanied by mild degrees of enteritis and may show mucus in the feces. The presence of mucus in appreciable amounts, however, can as a rule be taken to indicate outspoken enteritis. Anything which irritates the intestinal mucosa, whether mechanical or chemical, can produce enteritis. In the vast majority of instances, however, the disease is due to bacterial invasion. It may be merely a part of some well-characterized infectious disease, such as typhoid, cholera, amebic or bacillary dysentery or tuberculosis; it may be due to some recognizable bacterial invasion without a well-defined clinical complex, such as comes from contamination of food with the paratyphoid bacillus or the Staphylococcus (see "Food Poisoning"); or, while of infectious origin, it may be due to some unidentified organism. It may be due also to vitamin deficiency.

In most instances there is inflammation of the entire alimentary tract, so that the disease may be regarded as a true gastroenterocolitis. The nausea and vomiting which usually occur first probably represent acute gastrititis. The great prostration, thirst, fever and pains in the muscles are probably dependent on loss of water rather than on so-called toxemia.

Recognition of acute enteritis is based on the symptoms. The watery stools will in the beginning contain undigested food particles but later will contain little more than bacteria, water and mucus. There are myriads of microorganisms in the stools, and except in a few diseases, such as amebic dysentery, little can be learned from their study. Occasionally, as in epidemics due to the dysentery bacillus, agglutination tests will tell the story.

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9 A.M.: Milk toast
11 A.M.: Strained oatmeal gruel with milk
1 P.M.: Chicken or beef bouillon with 1 slice of dry toast
3 P.M.: *Strained oatmeal with milk;* 1 glass of milk
5 P.M.: Farina; 1 glass of milk
7 P.M.: Corn meal gruel; 1 glass of milk
9 P.M.: Milk

Seventh to Ninth Day

| | |
|---|---|
| 7 A M | Farina with a little butter 1 glass of milk |
| 9 A M | Coddled egg 1 slice of toast |
| 11 A M | Strained oatmeal with butter 1 glass of milk |
| 1 P M | Small piece of very tender broiled steak ½ slice of toast milk |
| 3 P M | 1 slice of toast butter 1 teaspoonful of jam or jelly |
| 5 P M | Milk toast with soft boiled egg |
| 7 P M | Toast butter marmalade 1 glass of milk |
| 9 P M | Strained oatmeal with butter 1 glass of milk |

Tenth to Twelfth Day

(Feedings may be changed to 6 to 8 A M if desired)

| | |
|---|---|
| 7 A M | Cream of Wheat with butter 1 glass of milk |
| 9 A M | Poached egg on toast 1 glass of milk |
| 11 A M | Milk toast (1 slice of toast 1 cup of hot milk butter) |
| 1 P M | Average helping of scraped beef patty toast jelly |
| 3 P M | Cream of Wheat with butter and milk |
| 5 P M | Small helping of creamed fish flakes 1 slice of toast |
| 7 P M | Soft boiled egg 1 piece zwieback |
| 9 P M | Toast marmalade milk |

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**Chronic Ulcerative Colitis** Chronic ulcerative colitis is an inflammatory disease of the large intestine The cause is unknown Bargen isolated a diplococcus which alone or in association with a filtrable virus he believed to be the causative factor but the specificity of this organism is not generally accepted Other organisms notably the *Shigella dysenteriae* have also been brought into causal relationship with this disease but their specificity likewise has been denied Secondary invaders of various types probably give color to the picture Nutritive deficiency apparently plays an important role but this role

is probably contributory rather than primary Allergy also appears at times to be a causative factor, in forty four of the eighty five cases studied by Mackie[11] there was clinical evidence of active food allergy Psychogenic influences likewise are said to constitute an important if not a primary, causative factor Sullivan,[12] for instance, reports that fifteen of eighteen patients with this disease whose psychologic back ground was studied had experienced emotional disturbances which could be regarded as of etiologic significance Grace and his associates[12a] had the unique opportunity of studying the effect of emotional stress on the human colon in four fistulous subjects They saw that emotional states such as anger and resentment are associated with hyperfunction of the colon which, when sustained, results in submucosal bleeding and ulceration There is some basis, therefore, for the belief that irritable colon, mucous colitis and ulcerative colitis represent different stages of the same process, all with an emotional background Mackie sum marizes the situation well when he states that the phenomena of this disease appear to result from the combined action of a number of factors and that not infrequently secondary deficiency states occur and assume major clinical importance The disease is increasing in fre quency

The *pathologic feature* of the disease has been defined by Mackie as fundamentally the sum of necrosis plus productive inflammation The mucosa is at first edematous and diffusely hyperemic it bleeds readily Later minute abscesses form, and their rupture produces a granular bleeding mucosa Most often the entire colon is affected and next in frequency, that part distal to the splenic flexure The picture varies widely

The *symptoms* usually begin insidiously, and with periods of exacer bation and spontaneous remission the disease runs a chronic course There is usually a bloody, purulent diarrhea although occasionally there is constipation As a rule there is fever Sooner or later evidences of nutritive deficiency appear *This disease is difficult at times to dis tinguish* from amebic dysentery and other diseases of the colon, although the sigmoidoscopic and the roentgenographic appearances in patients who have well advanced colitis are usually characteristic[13]

The outlook is as a rule bad, for, once established the disease tends to become chronic An example of this is seen in the statement of Willard and his associates[14] that of sixty six patients seen in a period of twelve years whose case histories were reviewed, 47 per cent were either dead or not improved, while 53 per cent were improved or in a remis sion The word "cure is today used with great caution Crohn prefers the term 'apparently arrested'

The *dietary treatment* of chronic ulcerative colitis should be accom panied by prolonged rest in bed and adequate psychotherapy A number of physicians following Bargen give the specific serum devised by him and in the cases of more chronic involvement the vaccine Others see no value in serums or vaccines unless perhaps there is some virtue in an autogenous vaccine made from some secondary invader Kiefer[15] states that, except in a small proportion of cases in which so called

vaccines or serums have been tried the treatment has been essentially nonspecific This is the usual practice

The diet should be of the smooth variety, free from roughage abundant in amount, liberal in protein and rich in vitamins and minerals In order to detect food allergy, Mackie advises the use of test diets Too much dependence should not be placed on the results of one test, for, according to this author, the colon sometimes exhibits a phasic variation in its response to certain foods, apparently corresponding to successive periods of sensitization and desensitization the test therefore should be repeated Idiosyncrasies to food were apparent in about half the cases of Mackie s group the foods most commonly at fault being milk eggs, oranges, wheat, spinach and tomatoes

Milk has seemed to me in most cases of ulcerative colitis to be eminently suitable Kiefer states that boiled milk is the basis of the diet in many of the cases at the Lahey Clinic This is definitely against the weight of opinion, however, for most physicians believe that milk is not well tolerated and advise against its use Patients who are allergic to milk or who have an idiosyncrasy for this food obviously cannot take it, but it is such an excellent food that I am inclined to believe that in all other instances prejudices should be waived and milk should be given a trial If well tolerated, 2 quarts daily may be given Thin slices of toasted white bread and a little cooked cereal (no bran) with milk should also be given The large amounts of cereals and other carbohydrate foods sometimes used are inadvisable

Protein should be given in liberal amounts Welch and his associates have shown that the losses of nitrogen in the feces, because of exudates and hemorrhage from the ulcerative surfaces, may reach considerable magnitude From their metabolic studies of patients with ulcerative colitis they conclude that the greatest need is for protein Mackie expresses a similar opinion Tender meats therefore in liberal amounts finely divided if necessary, and soft boiled or poached eggs should be given Fats in the form of butter and cream should be permitted sparingly

The need for vitamins should receive special consideration in chronic ulcerative colitis since hypovitaminosis due to failure of absorption is believed frequently to be responsible for continuance of the disease The need for vitamin $B_1$ is particularly urgent For this reason puréed vegetables orange juice and tomato juice should be given In addition the pure vitamins in crystalline form (ascorbic acid 100 mg and thiamine 10 to 20 mg) should be administered Haliver oil if well tolerated may also be given Penicillin, administered orally in doses of 100 000 to 300 000 units daily has been used with benefit The hypochromic anemias which often accompany this disease are said to respond to iron therapy[17] Liver extract has recently been given intramuscularly to a few patients with chronic ulcerative colitis apparently with great benefit It holds distinct promise

The relief of emotional stress should be emphasized I have apparently cured one of these patients by inducing her mother in law to be more considerate Grace and Wolf[17a] believe that favorable results can be

obtained only when a constructive physician patient relationship has been established

When medical means fail or bid fair to fail, surgical treatment offers some promise, but such a report as that of Willard and his associates[14] telling of an immediate postoperative mortality of 42 per cent and a death rate of 73 per cent in cases in which operation was resorted to gives one pause Of like tenor is the suggestion of Streicher,[18] who concludes that ileostomy should be reserved for the patient in whom the colon has undergone irreparable damage Thoreck[18a] recommends vagotomy and reports a 'favorable response' in 80 per cent of twenty one cases operated upon by him Much depends upon the condition of the patient, the location and extent of the lesions, and the type of operation

*Right Sided (Regional) Colitis* This is described by Crohn and his associates[19] as a distinctive subgroup of ulcerative colitis In addition to the diarrhea and abdominal pain, these patients have general symptoms, notably fever, involvement of the heart, arthritis and cutaneous manifestations Crohn and his colleagues state that the diagnosis of this segmental colitis is simple once the physician becomes conscious of the fact that colitis may occur even when sigmoidoscopic examination reveals no abnormality They report that the prognosis is good under conservative therapy in which is included strict nonroughage diet bed rest, abstention from vigorous exercise and the intramuscular injection of large doses of the various vitamins

**Table 101 Menus for Patients with Ulcerative Colitis (with Milk)**

I (Approximate values 150 gm of protein and 3000 Calories)

Breakfast

½ glass of orange juice
2 heaping tablespoonfuls of well cooked oatmeal with
1 sliced very ripe banana 2 ounces of thin cream
2 shirred eggs
1 slice of well toasted bread ½ teaspoonful of butter
1 glass of milk

10 30 A M

1 glass of milk

Dinner

⅔ glass of tomato juice
1 average helping of very tender lean roast beef
Medium sized baked potato 1 teaspoonful of butter
Average helping of purée of spinach
Average helping of mashed parsnips or carrots
1 slice of toast ½ teaspoonful of butter
Individually made apple whip

3 30 P M

*Milk and egg shake (no flavoring)*

Supper

Minced chicken (1 tablespoonful of cream or broth 1 slice of white meat minced heated served on toast)
1 heaping tablespoonful of hominy grits
Average helping of purée of green lima beans

1 slice of toast, ½ teaspoonful of butter
2 heaping tablespoonfuls of prune soufflé
1 glass of milk

Bedtime
½ glass of orange juice

II (Approximate values 150 gm of protein and 3000 Calories)
Breakfast
½ glass of grapefruit juice
½ cup of Cream of Wheat 1 teaspoonful of sugar and 2 ounces of thin cream
2 slices of well toasted white bread 1 teaspoonful of butter
1 tablespoonful of honey
1 glass of milk

10 30 A M
Scraped beef patty 1 tablespoonful of grits

Dinner
½ glass of tomato juice
Average helping of roast chicken (very tender white meat)
1 heaping tablespoonful of steamed rice
3 heaping tablespoonfuls of purée of English peas
2 slices of toasted white bread 1 teaspoonful of butter
1 large baked apple, 4 tablespoonfuls of soft custard
1 glass of milk

3 30 P M
1 glass of orange juice

Supper
12 panned oysters on hot plate 1 teaspoonful of butter
2 heaping tablespoonfuls of mashed potatoes
Average helping of purée of spinach
2 heaping tablespoonfuls of purée of squash
Apple tapioca pudding
2 slices of well toasted white bread
1 glass of milk

Bedtime
Milk and egg shake (no flavoring)

III (Approximate values 150 gm of protein and 3000 Calories)
Breakfast
Juice of average sized orange (½ cup)
4 heaping tablespoonfuls of farina 1 teaspoonful of sugar and 2 tablespoonfuls of cream
Average helping of brains scrambled with 1 egg
2 slices of toast 1 teaspoonful of butter
1 tablespoonful of apple sauce
1 glass of milk

10 30 A M
¼ glass of grape juice

Dinner
⅔ glass of tomato juice
Large helping of broiled beef patty
Medium sized baked potato

1 tablespoonful of lemon juice)
1 glass of milk

3 30 P M
½ glass of orange juice

Supper
Average helping of broiled liver patty
2 shirred eggs
Average helping of mashed carrots
2 pieces of zwieback ½ teaspoonful of butter
1 glass of milk

Bedtime
1 glass of milk and egg shake

**Table 101a Menus for Patients with Ulcerative Colitis (without Milk)**

I (Approximate values 125 gm of protein and 3000 Calories)
7 00 A M
½ cup of orange juice

Breakfast
2 heaping tablespoonfuls of well cooked oatmeal with
1 sliced ripe banana and 2 ounces of thin cream
Average helping of broiled sweetbreads
1 slice of well toasted white bread, ½ teaspoonful of butter

10 30 A M
1 soft boiled egg 1 slice of toasted white bread ½ teaspoonful of butter

Dinner
⅔ glass of tomato juice
Average helping of broiled scraped beef patty
1 medium sized baked potato ½ teaspoonful of butter
2 heaping tablespoonfuls of pureed lima beans
2 heaping tablespoonfuls of baked custard

3 30 P M
6 panned oysters on toast

Supper
1 tablespoonful of boiled rice ½ teaspoonful of butter
Average helping of strained stewed tomatoes
Average helping of sieved steamed squash
1 piece of zwieback ½ teaspoonful of butter
Average helping of egg soufflé
1 glass of grapefruit juice (half water)

Bedtime
½ cup of hot beef juice 6 crackers
Baked apple (without skin or core)

II (Approximate values 125 gm of protein and 3000 Calories)
Breakfast
Prune sauce (4 large puréed prunes)
4 tablespoonfuls of well cooked farina 1 teaspoonful of sugar and 2 tablespoonfuls of light cream
2 eggs scrambled
1 slice of well toasted white bread ½ teaspoonful of butter
1 cup of hot water or tea 1 teaspoonful of sugar 1 tablespoonful of thin cream

10 30 A M
1 glass of orange juice

Dinner
- 2 slices of very tender roast beef (no gravy)
- 1 tablespoonful of well cooked rice
- 3 heaping tablespoonfuls of purée of green peas
- 3 *heaping tablespoonfuls of purée of carrots*
- 2 slices of well toasted white bread 1 teaspoonful of butter
- Banana baked in skin
- ½ glass of tomato juice

3 30 P M
- Broiled ground liver patty 1 slice of toast ½ teaspoonful of butter

Supper
- Average helping of pan broiled scraped beef patty
- 2 heaping tablespoonfuls of creamed and mashed potatoes
- 2 heaping tablespoonfuls of purée of spinach
- 2 pieces of zwieback ¼ teaspoonful of butter
- Large baked apple without core or peel
- Soft custard (1 egg ⅓ cup of milk ¼ cup of water 1 teaspoonful of sugar)

Bedtime
- Average helping of well cooked oatmeal 2 tablespoonfuls of cream 1 teaspoonful of sugar

III (Approximate values 150 gm of protein and 3000 Calories)

7 00 A M
- ½ glass of orange juice

Breakfast
- 4 tablespoonfuls of Cream of Wheat 2 tablespoonfuls of thin cream
- 2 soft boiled eggs
- 1 slice of well toasted white bread ½ teaspoonful of butter
- 1 cup of hot water 1 teaspoonful of sugar 1 tablespoonful of cream

10 30 A M
- Broiled ground liver patty 1 slice of toast ½ teaspoonful of butter

Dinner
- Average helping of tenderloin steak
- 2 heaping tablespoonfuls of creamed potatoes
- Scalloped tomatoes (2 tablespoonfuls of tomato pulp 1 slice of bread ½ teaspoonful of butter)
- 2 heaping tablespoonfuls of puréed green lima beans
- 2 slices of well toasted white bread 1 teaspoonful of butter
- Prune soufflé (½ cup of stewed and sieved prunes 2 egg whites whipped and folded in)

3 30 P M
- ½ glass of tomato juice

Supper
- Average helping of calves brains scrambled with 1 egg
- 1 heaping tablespoonful of hominy grits ½ teaspoonful of butter
- 2 pieces of zwieback 1 teaspoonful of butter
- Banana cream pudding (1 ripe banana 4 tablespoonfuls of soft custard)

Bedtime
- Baked apple

*Elimination Diets* Elimination diets are sometimes used for diagnostic as well as therapeutic purposes The following menus provide no milk, wheat, eggs, oranges, tomatoes or spinach, the articles to which

3 30 P M
  ½ glass of orange juice

Supper
  Average helping of broiled liver patty
  2 shirred eggs
  Average helping of mashed carrots
  2 pieces of zwieback, ½ teaspoonful of butter
  1 glass of milk

Bedtime
  1 glass of milk and egg shake

**Table 101a Menus for Patients with Ulcerative Colitis (without Milk)**

I *(Approximate values 125 gm of protein and 3000 Calories)*
7 00 A M
  ½ cup of orange juice

Breakfast
  2 heaping tablespoonfuls of well cooked oatmeal with
  1 sliced ripe banana and 2 ounces of thin cream
  Average helping of broiled sweetbreads
  1 slice of well toasted white bread, ½ teaspoonful of butter

10 30 A M
  1 soft boiled egg 1 slice of toasted white bread, ½ teaspoonful of butter

Dinner
  ⅔ glass of tomato juice
  Average helping of broiled scraped beef patty
  1 medium sized baked potato ½ teaspoonful of butter
  2 heaping tablespoonfuls of pureed lima beans
  2 heaping tablespoonfuls of baked custard

3 30 P M
  6 panned oysters on toast

Supper
  1 tablespoonful of boiled rice, ½ teaspoonful of butter
  Average helping of strained stewed tomatoes
  Average helping of sieved steamed squash
  1 piece of zwieback, ½ teaspoonful of butter
  Average helping of egg soufflé
  1 glass of grapefruit juice (half water)

Bedtime
  ½ cup of hot beef juice 6 crackers
  Baked apple (without skin or core)

II (Approximate values 125 gm of protein and 3000 Calories)
Breakfast
  Prune sauce (4 large pureed prunes)
  4 tablespoonfuls of well cooked farina 1 teaspoonful of sugar and 2 tablespoonfuls of light cream
  2 eggs, scrambled
  1 slice of well toasted white bread ½ teaspoonful of butter
  1 cup of hot water or tea 1 teaspoonful of sugar, 1 tablespoonful of thin cream

10 30 A M.
  1 glass of orange juice

Dinner
- 2 slices of very tender roast beef (no gravy)
- 1 tablespoonful of well cooked rice
- 3 heaping tablespoonfuls of purée of green peas
- 3 heaping tablespoonfuls of purée of carrots
- 2 slices of well toasted white bread 1 teaspoonful of butter
- Banana baked in skin
- ½ glass of tomato juice

3 30 P M
- Broiled ground liver patty 1 slice of toast ½ teaspoonful of butter

Supper
- Average helping of pan broiled scraped beef patty
- 2 heaping tablespoonfuls of creamed and mashed potatoes
- 2 heaping tablespoonfuls of purée of spinach
- 2 pieces of zwieback ⅙ teaspoonful of butter
- Large baked apple without core or peel
- Soft custard (1 egg ⅔ cup of milk ¼ cup of water 1 teaspoonful of sugar)

Bedtime
- Average helping of well cooked oatmeal 2 tablespoonfuls of cream 1 teaspoonful of sugar

III (Approximate values 150 gm of protein and 3000 Calories)

7 00 A M
- ½ glass of orange juice

Breakfast
- 4 tablespoonfuls of Cream of Wheat 2 tablespoonfuls of thin cream
- 2 soft boiled eggs
- 1 slice of well toasted white bread ½ teaspoonful of butter
- 1 cup of hot water 1 teaspoonful of sugar 1 tablespoonful of cream

10 30 A M
- Broiled ground liver patty 1 slice of toast ½ teaspoonful of butter

Dinner
- Average helping of tenderloin steak
- 2 heaping tablespoonfuls of creamed potatoes
- Scalloped tomatoes (2 tablespoonfuls of tomato pulp 1 slice of bread ½ teaspoonful of butter)
- 2 heaping tablespoonfuls of puréed green lima beans
- 2 slices of well toasted white bread 1 teaspoonful of butter
- Prune soufflé (½ cup of stewed and sieved prunes 2 egg whites whipped and folded in)

3 30 P M
- ½ glass of tomato juice

Supper
- Average helping of calves brains scrambled with 1 egg
- 1 heaping tablespoonful of hominy grits ½ teaspoonful of butter
- 2 pieces of zwieback 1 teaspoonful of butter
- Banana cream pudding (1 ripe banana 4 tablespoonfuls of soft custard)

Bedtime
- Baked apple

*Elimination Diets* Elimination diets are sometimes used for diagnostic as well as therapeutic purposes The following menus provide no milk wheat, eggs, oranges, tomatoes or spinach, the articles to which

patients most often exhibit idiosyncrasy To these diets should be ad a concentrated preparation of vitamin A, 10 mg of thiamine and mg of ascorbic acid daily As the patient improves, puréed vegetal may cautiously be added

Table 102 Elimination Diet for Patients with Ulcerative Colitis
(Menus eliminating foods to which patients are most often sensitive)

I (Approximate values 175 gm of protein and 2800 Calories)
Breakfast
- ½ canned pear with sauce
- ½ cup corn flakes 2 ounces of 20% cream
- 3½ ounces of ground liver (all fiber removed made into patties seasoned w salt broiled in 1 teaspoonful of butter)
- 2 pieces of zwieback 1 teaspoonful of butter
- 1 tablespoonful of jelly or jam
- 1 cup of cracked cocoa

Dinner
- Large serving of roast chicken (white meat only)
- 1 heaping tablespoonful of boiled or steamed rice 1 teaspoonful of butter
- 4 heaping tablespoonfuls of puréed English peas
- 2 small corn pones 2 teaspoonfuls of butter
- 3 heaping tablespoonfuls of Floating Island pudding
- 1 banana baked in skin

Supper
- Average sized slice of broiled tenderloin steak
- Medium sized baked potato 1 teaspoonful of butter
- ½ cup of purée of green lima beans
- 2 rye and rice muffins 1 teaspoonful of butter
- 2 heaping tablespoonfuls of blanc mange (no 2) 1 ounce of 20% cream

II (Approximate values 125 gm of protein and 2600 Calories)
Breakfast
- 1 medium sized banana baked in skin
- 3 heaping tablespoonfuls of Indian meal mush with 1 ounce of 20% cream
- 1 large (3½ ounce) broiled scraped beef patty 1 teaspoonful of butter
- 2 slices of well toasted white bread
- 1 teaspoonful of butter, 1 tablespoonful of jam or preserves

Dinner
- Large serving (4 ounces) of liver patty (ground with all fiber removed and broi with butter)
- 3 tablespoonfuls of hominy grits 1 teaspoonful of butter
- ½ cup of purée of green lima beans
- 2 rye and rice muffins 1 teaspoonful of butter
- 2 heaping tablespoonfuls of rice custard

Supper
- Minced chicken (large portion of white meat) on toast (no seasoning except little salt water)
- 1 tablespoonful of boiled rice
- Average helping of well sieved squash
- 1 piece of zwieback ½ teaspoonful of butter 1 teaspoonful of jelly
- Orange or lemon Jello

III (Approximate values 125 gm of protein and 2500 Calories)
Breakfast
- 1 heaping tablespoonful of stewed apricots
- 3 tablespoonfuls of hot buttered grits 1 teaspoonful of butter

- 3½ ounces of ground liver (all fiber and skin removed made into patties and broiled)
- 2 rye and rice muffins with 1 teaspoonful of butter
- 1 tablespoonful of jam or honey

Dinner

- Large serving of roast breast of chicken
- Medium sized baked potato 1 teaspoonful of butter
- ½ cup of puree of green lima beans
- Average helping of mashed carrots
- 2 small corn pones 2 teaspoonfuls of butter
- 2 heaping tablespoonfuls of bread pudding with raisins served with 1 ounce of heavy cream

Supper

- Average serving (4 ounces) of tenderloin steak (no fat) or scraped beef patties butter
- 3 heaping tablespoonfuls of rice 1 teaspoonful of butter
- 4 heaping tablespoonfuls of purée of peas
- 2 pieces of zwieback 1 teaspoonful of butter
- 2 halves canned pears (no fibers) with juice

**Regional Ileitis** Regional ileitis is a chronic illness, chiefly of young adults manifested by diarrhea fever continuous loss of weight and progressive anemia Its clinical course is not unlike that of chronic ulcerative colitis The cause is unknown

The *symptoms* are fairly well defined The patient has two or more stools daily, always with mucus and sometimes with blood Crohn and his associates,[20] who were the first to describe this disease, told of dull cramplike pains in the lower part of the abdomen, most often present just prior to, but relieved after, defecation If a fistula forms between the adherent ileum and the sigmoid flexure, as sometimes occurs a mass can be felt The authors just quoted list the most characteristic physical findings as (1) a mass in the right iliac region, (2) evidences of fistula formation, (3) emaciation and anemia (4) the scar of a previous appendectomy, and (5) evidences of intestinal obstruction Moderate leukocytosis is usually though not invariably present

In the roentgenogram an irregular filling defect of the ileum is seen, with a tendency toward stenosis The string sign,' a thin, slightly irregular line or shadow suggesting a cotton string extending through the entire filling defect as described by Kantor,[21] is characteristic

*Pathologically*, regional ileitis is a granulomatous process, progressive in nature and limited as a rule to the distal 10 to 14 inches (25 to 35 cm) of the ileum Because of the inflammatory hyperplastic and exudative changes the wall of the bowel becomes enormously thickened, the lumen becomes narrowed, and sometimes there is eventual stenosis Irregularly placed ulcers occur, and fistulas frequently form between the several segments of the bowel

The disease probably never heals of itself, and the patient should always be given the benefit of surgical intervention Indeed, in his discussion of the prognosis Crohn[22] states that there is no known medical treatment of this disease Of radical resection he writes 'In spite of the extent of the procedure, the risk seems twice as great when

surgical aid is refused the patient," and if the patient is in the best of hands operation offers an excellent prognosis

*Dietary regulation*, nonetheless, adds greatly to the patient's comfort While he is waiting for operation, when for any reason operation is not done, or, according to Keifer and Arnold,[22a] after operation has been done, dietary care should be continued The pain, discomfort and diarrhea are often thereby relieved The food should be of the smooth type and free from roughage It should consist of milk, cereals with cream eggs tender meats, white breads and puréed vegetables and such simple desserts as cup custard and rice pudding The type of diet advised for the irritable colon, with such further restriction as the severity of the condition demands, is appropriate Patients who are acutely ill should for a time be given only milk and well cooked cereals that are free from bran

**Intestinal Amebiasis** An outbreak of amebiasis in Chicago a number of years ago focused attention upon this disease, and subsequent observation has demonstrated that it is much more frequent and widespread than formerly was thought Albright and Gordon[23] have pointed out that large numbers of unsuspected and unreported cases were brought to the United States by the returning Armed Forces The manifestations vary widely *Endamoeba histolytica* is never the harmless inhabitant of the intestinal tract that some persons believe it to be it is a true parasite and always does damage in greater or less degree to the intestinal mucosa In the cases of mildest amebiasis this damage may be so slight as to be recognizable only microscopically, but in cases of severer involvement there is extensive ulceration with great destruction of the mucosa Such lesions most commonly occur in the cecum and ascending colon, although any part or all of the colon sigmoid flexure and rectum may be attacked

The *symptoms* vary widely and do not always include dysentery Indeed, in a great many cases there is neither dysentery nor diarrhea in spite of extensive ulceration in the colon The abdomen is usually tender to pressure and sometimes rigid, and, indicating hepatitis, there may be pain and tenderness in the hepatic region

The *diagnosis* depends upon the identification of *E histolytica* or of cysts in the feces for which appropriate technical skill is required

In the *treatment* of this disease a host of drugs have been used, the individual merits of which cannot be discussed here Mackie[24] states that since no one of these drugs is completely efficient a combination should be used He recommends a combination of emetine, which acts primarily upon the amebas in the tissues and one of the oxyquinoline derivatives such as chiniofon (yatren) or iodoxyquinoline sulfonate (anayodin), which acts on the contents of the colon and the surface of the mucosa In refractory cases due to secondary bacterial invasion Hargreaves[25] has seen excellent results from the administration of penicillin and succinylsulfathiazole Great faith today is placed in these newer antibiotics but a disadvantage here is that these drugs tend to diminish the intestinal bacteria which play an important role in the

maintenance of normal nutrition [25a] Always during the acute stage and often during the chronic stage the patient should be kept in bed, and the pain as well as the diarrhea controlled with morphine

The *diet* during the acute stage should be rigidly restricted only a little barley water and perhaps chicken broth or beef broth should be permitted Milk has always been regarded as the most appropriate food in amebic dysentery Strong advised an all milk diet at first, to which may be later added, as the symptoms subside, gruels, cereals with milk, toast and soft boiled eggs Later, tender meats, such as roast beef, chicken and lamb chops, and rice or mashed potatoes may be added Pureed vegetables in limited quantities may also be given The diet should be restricted to articles of this type until all evidence of intestinal irritation have subsided, which may mean many months To prevent vitamin deficiency in the chronic stage liver, orange juice and tomato juice and perhaps ascorbic acid and thiamine in crystalline form should be given For the constipation which in the chronic stage often alternates with diarrhea, recourse may be had to plain agar, in large quantity if necessary, but never to vegetables and other rough foods The menus suggested for chronic ulcerative colitis are often suitable in this disease also

**Other Protozoan Infections** Other protozoan infections of the bowel have a wider geographic distribution than was formerly thought Kessel and Mason reported from southern California that 60 per cent of their patients who showed symptoms of colitis had intestinal protozoan infections They found that patients harboring *E histolytica* exhibit symptoms of colitis about three times as frequently as those without intestinal protozoa They found, too, that in cases in which flagellates (Giardia, Chilomastix and Trichomonas) are present, gastrointestinal symptoms are more frequent than in cases in which no protozoa are present but that this association is less frequent than in the cases in which *E histolytica* is found They report that mucous colitis and constipation show no such association but that two of the flagellates Chilomastix and Trichomonas, are found with more than usual frequency in cases of disease of the gallbladder and of duodenal ulcer

Infection with *Giardi intestinalis* is the most serious of the flagellate infections That it is not rare among inhabitants of the temperate zone is seen in the studies of MacPhee and Walker [26] who found six instances of infection among 732 patients They report nausea and pain in the upper portion of the abdomen as the most frequent symptoms, with the occasional appearance of tenderness of the gallbladder, enlargement of the liver, and jaundice The intermittent diarrhea may become sufficiently severe to simulate amebic dysentery, although as a rule it is neither so severe nor so persistent Infections with *Trichomonas hominis* and with Chilomastix, which are less serious usually produce mild diarrhea of short duration

The *dietary regulation* suitable in these protozoan infections is that advised for intestinal amebiasis Care should be taken that dietary restriction is not carried to the point where nutritive failure is imminent

## HABITUAL CONSTIPATION

Constipation is the incomplete or infrequent emptying of the lower portion of the bowel To define the words incomplete and infrequent however, is difficult Most persons probably empty only the rectum sigmoid flexure and lower part of the descending colon at defecation but others evacuate everything from the splenic flexure onward or even from some higher point As to frequency, the majority of persons for comfort and health must have a daily bowel movement but others require an evacuation only every second or third day Indeed instances have been recorded of persons who, while maintaining apparent health and attending to their daily duties, have a bowel movement only at intervals of several weeks or even longer Apparently, wide variations in this respect are thoroughly compatible with health

Such differences in reactivity to an overfilled colon can best be explained by an inquiry into the nature of its baneful effects These harmful influences of constipation are commonly believed to be due to the absorption of toxins from the colon so-called autointoxication but as was convincingly demonstrated by Alvarez[29] it is probable that this belief has little basis in fact Everyone knows that when during constipation evacuation of the bowels has been accomplished relief is as a rule immediate yet it is evident that if absorbed poisons were the cause of the discomfort, this relief could not be experienced so quickly As Alvarez aptly expresses it, one can just as well talk of sobering a drunken man by taking the bottle out of his hip pocket Some other explanation must be sought

Unquestionably, infrequent or insufficient bowel movement leads to a certain well recognized train of symptoms malaise headache hebetude poor appetite, coated tongue and foul breath Additional clearly defined harmful effects including easy fatigability loss of the power of concentration and delayed reaction time of the special senses were demonstrated by Donaldson[30] on five normal men who voluntarily refrained from bowel movement for a period of about four days. These men experienced a complete return to normal within an hour after securing a bowel movement by enema The suggestion has been made repeatedly, and this seems most reasonable that the described disturbances are due to pressure of the fecal mass both on a sensitive mucous membrane and on the pelvic nerves and perhaps also to reverse peristalsis This discomfort and distress of an overloaded intestine are genuine, but nonetheless in the last analysis they appear to be largely of nervous origin Differences in reactivity are due to differences in individual nervous susceptibility

The *physiology* of the large intestine is entirely different from that of the small intestine *Its chief function is to hold the feces* until it is convenient to defecate, it serves therefore during the greater part of the time merely as a reservoir The liquid chyme passes rapidly through the small intestine and is ejected in spurts into the cecum it is prevented from regurgitating by the ileocecal sphincter The feces accumulate in the cecum and ascending colon where, through the absorption of water, they are changed to a soft, semiliquid mass Further absorption

of water occurs as the transverse colon is reached, where the feces take on a firmer, semisolid consistency Without recognizable waves, this material is pushed gradually forward to the hepatic flexure, but from this point onward it travels not by gradual progression, but by a few periodic forceful movements of the mass These powerful peristaltic waves involving the greater part of the large intestine are repeated five or six times daily They have been seen to follow the taking of food into the stomach, which is now regarded as the normal stimulus for the colonic reflex Being periodically carried forward in toto, the fecal mass finally reaches the pelvirectal flexure, where, owing to the tonic contraction of the circulatory muscular fibers, further progress is temporarily stopped

Nothing enters the rectum until immediately before defecation At the usual time for this act, as a rule just after breakfast, there is relaxation of the muscle fibers at the flexure, and active peristalsis of the colon carries forward a portion of the feces into the rectum The circumstances which give rise to this movement are numerous and complex, the renewed reactivity of the bowel which follows the night s rest, the active movements of the early morning the usual glass of cold water, the cold bath perhaps and above all the taking of food The presence of feces in the rectum then gives rise to a sensation of fulness—a muscle sense rather than a tactile sense which is in turn produces the desire to defecate As the person goes to stool, defecation is initiated by certain voluntary movements of the diaphragm, the abdominal muscles and the levator ani muscle This increases the abdominal pressure and forces additional feces into the rectum the distention then giving rise to reflex impulses from the lumbar portion of the spinal cord This brings about propulsive movements of the colon and simultaneous relaxation of both anal sphincters which results in an emptying of the distal part of the large intestine

*The entire colon is not completely emptied at defecation,* a certain amount of fecal material remains in the ascending and the transverse colon This goes forward during the day and is presumably evacuated *the following morning There may be however even under normal circumstances,* considerable delay in the passage of the feces Witness the experiment of Alvarez and Freedlander[31] who gave fifty glass beads each to normal subjects and observed that 15 per cent were passed the first day, 40 per cent the second, 15 per cent the third and 10 per cent the fourth day The rate of progress varied widely in healthy persons, some of whom took a week or more to pass 70 per cent of the beads Rapid progress of the beads, 85 per cent in twenty four hours, was associated with soft badly digested stools while the slower rates resulted in material that was better formed and more completely digested The propriety of interpreting the passage of these beads as a fair criterion of intestinal activity may be questioned, but the studies are highly suggestive

The *causes* of constipation are manifold Anything which alters the physical state of the fecal content or which, by impairing the functional integrity of the intestinal musculature or by other means, interferes

with the finely coordinated movements of the alimentary tract will produce constipation According to the classification of Spencer,[32] these causes can be described as follows

1 Dietary faults which result in deficient residue or otherwise produce a fecal content of improper consistency, an insufficient intake or an increased absorption of fluids

2 *Interference with the defecation reflex*, such as comes from repeated lack of response to the urge for defecation or from injury to the nervous mechanism, such as occurs in tabes dorsalis, and difficult or painful defecation, such as is produced by fissures, painful hemorrhoids and hard fecal masses

3 The use of laxatives and cathartics These frequently defeat the purpose for which they are given, for the irritation and inflammation they cause may lead to intestinal spasm The alteration in secretions and reduction in fecal contents which they produce also have an unfavorable effect Normally there remains in the ascending and perhaps a part of the transverse colon after each defecation a certain amount of fecal material which later passes forward to be evacuated the following day, if a drastic purgative is taken, however, the entire large intestine is emptied and nothing remains for evacuation the next day Thus it is evident that failure of the bowels to move on the morning following a day of purgation is not due, as has been supposed, to temporary paralysis of the intestine, but rather to the fact that there is nothing to move After purgation has been produced, no further bowel movement should be expected within a period of forty eight hours or even longer The insistence of a certain type of patient that he have a daily bowel movement at all times and his consequent use of purgatives eventually lead to habitual constipation

4 Lack of exercise, which leads to weakness of the skeletal muscles and poor tone of the intestinal musculature Any change in physical activity (an ocean voyage!) may so interfere with the neuro muscular control of the bowel as to produce constipation

5 Obstruction such as often comes from adhesions and kinks in the intestine, notably in the terminal portion of the ileum, the ascending colon and the hepatic and splenic flexures

6 Stasis from any of these causes, which by permitting the extraction of water from the intestinal contents, produces hard fecal masses and accentuates the difficulty

7 Spasm of the intestine This is a frequent cause of constipation It may be the expression of abnormal irritability or of the presence of irritating material, or both The resulting accumulation of hard fecal masses often leads to localized inflammation when limited to the rectum and sigmoid flexure, it is called *dyschesia* Psychogenic influences can sometimes be included in this category

In the *correction* of constipation regularity of habit comes first The patient should go to the toilet at a definite time of day, after breakfast is best, but calls should be responded to wherever and whenever they

come It is important that the person be in no hurry, that he be com fortable and that the toilet be agreeably warm For many men the smoking of a cigar brings that degree of comfort and relaxation which favors proper and well coordinated reflex action, as does the reading of the morning paper A proper stooped over position, which will permit the abdominal muscles full action, is of help, and to this end a foot stool is often advisable This applies particularly to the child, who should never be permitted to sit on the toilet with his feet dangling over

The person who lives under high tension or whose neurotic tendencies produce spastic constipation should be taught to relax This is the type of patient whose constipation, as emphasized by Dejerine and Dubois, can often be cured by psychotherapy and related measures First it is necessary to explain to such a person that failure to have a bowel movement for one perhaps two days is not after all serious and that it will not make him sick He must relinquish this phobia if he is to recover from constipation Other conditions which contribute to the disorder or constitute its underlying cause must be corrected It should not be forgotten that constipation is the symptom of a great many disorders which themselves must be treated if the constipation is to be cured

The *diet* to be prescribed depends upon the kind of constipation The food should be sufficient in amount and reasonably rich in vitamins and minerals and, except in cases of spastic constipation, should provide an abundance of roughage Witness the animal experiments of Robert son and Doyle,[33] who observed that young rats fed on a diet low in minerals had marked intestinal stasis, while control animals fed the same diet plus minerals did not For patients who cannot take the rougher vitamin carrying foods, the concentrated vitamin preparations should be prescribed Yeast is valuable in this respect, but it is some times too irritating, in which case crystalline thiamine (3 to 10 mg daily) should be prescribed

Roughage is prescribed because of its hygroscopic effect, but not all roughage is of equal value Williams and Olmsted[34] in their study of laxation from crude fiber call attention to the fact that this substance is not a chemical entity and report that of its several components hemi cellulose has the greatest laxative effect In the section on roughage (p 132) is a table which gives the crude fiber content of various vege tables Briefly, the leafy vegetables, such as lettuce, spinach, cabbage, and cauliflower, are most important, asparagus, tomatoes, onions and legumes are also good Fruits are always valuable—apples, pears, or anges and grapes Dried fruits such as figs, raisins and prunes, are good and when cooked make a delicious dish to be eaten with breakfast foods and cream Honey and the various preserved fruits have a mildly laxative effect

Whole wheat bread and bran may be prescribed for patients who can take roughage However, children and adults who have sensitive di gestive tracts do not as a rule tolerate these articles, and sometimes a great deal of digestive discomfort is unwittingly produced by their use

In such instances agar or a preparation made from psyllium seed is greatly to be preferred

The statement that milk is constipating is, I believe slander against a very important food The only objection to milk is that the patient who takes it in large quantities is less likely to eat other foods in amounts sufficient to give him the necessary roughage It is proper to give milk to the constipated patient, provided he obtains sufficient crude fiber from his other foods

Meats eggs fish and other more concentrated foods have a proper place in the dietary of constipation, but the patient should take these foods merely in order to meet his nutritive requirements and should fill in with green vegetables

Fats are of considerable help, for the fatty acids, when not excessive in amount, have a stimulating effect on the mucous membrane, they are best given in the form of cream, butter, bacon and oil dressings

For patients with a sensitive gastrointestinal tract, notably those who are said to have an irritable colon and to suffer from "spastic constipation," the foregoing advice regarding roughage will work harm Unfortunately, the food in such cases must be of a different type Not infrequently a patient so handicapped is encountered who, in the effort to cure his constipation, takes large quantities of green vegetables whole wheat and bran and is constantly miserable Give such a patient a smooth diet such as is advised for the irritable colon, and the results as a rule will be highly gratifying

Because of the need for minerals and vitamins however, fruits and vegetables cannot be entirely eliminated from the diet When these articles have been puréed or mashed through a sieve, they no longer have the irritating effects of the coarser materials and in this form they can be taken with comfort All so called smooth diets, therefore except in rare instances, should provide puréed vegetables and fruits To compensate for the lack of bulk and the change in consistency entailed by the smooth diet, plain agar should be given in liberal quantities (not agar mixed with oil) Its consistency is such that it will not injure the mucous membrane of the stomach or intestine, yet through the absorption of water it will give to the bowel content the proper bulk Agar is not a drug and can with impunity be taken in any amount

High fat diets are sometimes of value Miss Florence H Smith[35] of the Mayo Clinic, devised a diet which provides approximately 164 gm of carbohydrate, 66 gm of protein and 224 gm of fat, with a food value of 3026 Calories The following foods are included in the daily menu

5 per cent vegetables 50 gm raw 50 gm cooked and 10 per cent fruits 50 gm juice of orange 100 gm raw or cooked 200 gm of potato (baked) 2 eggs 60 gm of white bread 20 gm of broiled bacon 50 gm of lean meat 460 gm of 20 per cent cream 400 gm of milk 50 gm of butter 45 gm of mayonnaise (85 per cent fat) 20 gm of cereal (bland) 15 gm of sugar 200 cc of coffee and 1000 cc of water

Too much fat, however will cause diarrhea or perhaps diarrhea alternating with spastic constipation, and for this reason such high fat diets are suitable only in selected cases

**Table 104 Menus for Patients with Chronic Constipation**

I

*Before Breakfast*
2 glasses of hot water with juice of ½ lemon a little salt

Breakfast
Whole wheat cereal with cream
Prunes or apple sauce
Whole wheat and raisin muffins butter
1 soft boiled egg

Dinner
Baked fish with tomato sauce
Buttered asparagus
Spinach with egg yolk
Chopped celery and tomato salad
Corn muffins butter
Scalloped apple pudding with cream
Buttermilk

Supper
Purée of pea soup with crackers
Baked tomato stuffed with celery
Creamed cabbage
Beet and egg salad
2 slices of cracked wheat bread butter
Baked apple with cream

Bedtime
3 or 4 figs

II

Before Breakfast
*Hot water with lime or lemon juice*

Breakfast
Triscuits with hot milk
Dried frizzled beef
Shirred egg
2 slices of whole wheat toast butter

Dinner
Meat loaf with gravy
Scalloped onions
Stewed celery and tomatoes
Lettuce with Thousand Island dressing
Bran muffins butter
Prune soufflé
Buttermilk

Supper
Panned oysters on toast
Buttered cauliflower
Spinach salad
Stewed apricots
Heated whole wheat biscuit with butter
Milk

Bedtime
All Bran with prune juice

*III*

Before Breakfast

2 cups of hot lemon water with salt

Breakfast

Bran with stewed fruit and cream
Egg omelet with tomato
Plain muffin with butter and honey

Dinner

Roast lamb mint jelly
Buttered carrots
Apple celery and raisin salad
Whole wheat bread butter
Peach whip with whipped cream
Buttermilk

Supper

Vegetable soup
Beet and egg salad
Baked apple with cream
Bran muffins butter

Bedtime

Triscuits with orange juice

IV

Before Breakfast

2 cups of hot water and fruit juice

Breakfast

Whole bran with cream and prune sauce
Coddled egg bacon
Graham muffins butter preserves

Dinner

Baked fish with cheese sauce
Buttered onions
String beans
Lettuce and tomato salad
Corn muffins butter
Stewed apple
Buttermilk

*Supper*

Scalloped eggs with green peas
Buttered carrots
Celery and olives
Apple tapioca with cream
Bran muffins butter

Bedtime

4 or 5 prunes or figs

*V*

Before Breakfast

Hot lemon water with salt

Breakfast

*Whole wheat biscuit with rich milk*, stewed fruit
Panned oysters on toast bacon
Popovers butter honey

Dinner
- Roast veal with dressing
- Turnip greens with turnips
- Dried or green lima beans
- Apple carrot and raisin salad
- Bread and butter
- Jello with whipped cream and nuts
- Milk

Supper
- Cream of tomato soup triscuits
- Buttered onions
- Tomato and celery salad
- Fruit compote
- Graham muffins or bread butter

Bedtime
- 2 tablespoonfuls of raisins

VI

Before Breakfast
- 2 cups of hot water and orange juice

Breakfast
- Pettijohn cereal or Huskies with cream and apple sauce
- Scrambled egg bacon
- Bran muffins butter honey or marmalade

Dinner
- Roast beef with scalloped tomatoes
- Spinach with egg yolk
- Buttered cabbage (cooked 10 minutes)
- Lettuce and Thousand Island dressing
- Stewed apple with custard sauce
- Corn muffins
- Milk

Supper
- 1 egg omelet jelly
- Creamed celery
- Green peas
- Rice pudding with raisins
- Whole wheat or cracked wheat bread butter
- Milk

Bedtime
- Triscuits and prune sauce

## INTESTINAL AUTOINTOXICATION

Intestinal autointoxication is a term of uncertain meaning which has been vaguely applied to a wide variety of symptoms believed to come from the absorption of poisons from the intestinal tract There is much to suggest that poisons elaborated in this tract may enter the circulation and become injurious but few arguments in substantiation of such a belief will stand critical scrutiny The greatest blame has apparently been attached to products of protein decomposition, which make themselves evident by the presence of indican in the urine but in spite of a voluminous literature, most of it conjectural, some of it experimental no one has been able to show that indicanuria has any far reaching clinical significance The evidence in support of other forms

of poisoning from products of intestinal decomposition, whether from protein, carbohydrate or fat, is equally lacking in substantiation. The body has two effective lines of defense which prevent ready access of intestinal poisons to the general circulation: first, the intestinal mucosa and, second, the liver. Under normal conditions, poisons which may be absorbed from the intestinal tract are as a rule destroyed by one or the other of these defensive organs. After a critical examination of all the evidence for and against intestinal autointoxication as a cause of disease, Alvarez[29] reached the Scottish verdict of "not proven," but with an evident leaning toward "not guilty."

The passage of bacteria themselves through the intestinal wall, to which Adami gave the term "latent" or "subinfectious," is of fairly frequent occurrence. It is a much more probable source of trouble.

Since the kind of poison responsible for so-called intestinal autointoxication, if such there be, is uncertain, dietary precautions directed against it are difficult to formulate. When a disorder of this sort is suspected, the stools should be studied according to the Schmidt method and dietary corrections made accordingly. When there are evidences of intestinal putrefaction, with poor digestion of meat, a protein-poor diet should be advised; if there are evidences of poor utilization of carbohydrate, a diet that is carbohydrate-poor and protein-rich should be prescribed. If it seems desirable to change the nature of the intestinal flora, this can best be accomplished by confining the patient for a time to acidophilus milk to which has been added a relatively large amount of lactose. He should be given this milk (2 quarts daily) for a week or ten days, after which cereals, preserves and other foods should be added.

For a complete discussion of intestinal autointoxication the reader is referred to the critical review by Alvarez.[29]

## DISEASES OF THE LIVER

As the "commissariat of the body," the liver is the most important of the organs concerned in the elaboration of food. Disease of this organ may demand dietary adjustment from three different angles: (1) Failure of any of its several regulatory functions will lead to profound metabolic disturbances, some of which can be anticipated and in a measure prevented by diet. (2) Lack of bile in the intestinal tract will unfavorably influence digestion and absorption. (3) Venous congestion, such as accompanies obstruction to the portal circulation, will interfere with the secretory and motor activity of the intestinal tract. Any discussion of diet in diseases of the liver should, therefore, be preceded by a consideration of the functions of this organ. These include its relation to protein metabolism, its control over carbohydrate metabolism and its role in the utilization of fat and the formation of bile.

The liver is intimately concerned in protein metabolism. It stores the larger part of the amino acids as they are absorbed from the intestine and subsequently resynthesizes them into body protein or breaks them down for combustion and ultimate deamination. It is drawn upon first and to the greatest degree when there is need for protein for fuel.

These reserves are also extensively drawn upon to replace plasma proteins when the latter are broken down to be recast into specific cell protein The liver holds the last reserves of body protein

Of equal importance is the controlling influence which the liver exerts over carbohydrate metabolism Witness the fatal hypoglycemia with characteristic symptoms which was produced in the liver extirpation experiments of Mann and the relief of symptoms which obtained for a time when dextrose was administered [37] While reserves of carbohydrate in the form of glycogen are stored in about equal amounts in the muscles and the liver, that in the liver is in much greater concentration and of greater physiologic significance According to Mann,[37] only the glycogen of the liver is capable of conversion into dextrose and of being mobilized for direct utilization of the body cells

Fat also is stored in the liver, and here the most significant changes of fat metabolism take place [38] These stores of fat, like those of carbohydrate, vary greatly in amount, and, since an increase in one leads to a decrease in the other, the two seem to have a reciprocal relationship

Many other functions are performed by this versatile organ Prominent among these are the pigment forming function and the function of elaborating the protein precursors from which the plasma proteins are formed To the first of these Whipple[39] attributes the "pigment complex," a group of substances essential to the formation of mature body pigments To the latter function great importance is attached by Snell,[40] who states that the rapidity with which changes in the value for total protein and in the albumin globulin ratio may take place in chronic disease of the liver is rather striking and that these changes are not without prognostic significance Witness, too, the part played by this organ in the metabolism of the vitamins Most of the vitamin A is stored in the liver, and its precursor carotene is converted here into the vitamin The importance of another function of the liver, that of forming the bile salts, is impressed upon the student of nutrition not only because these salts retard intestinal putrefaction and make possible the utilization of fat, but also because they are necessary to the absorption of many substances, notably certain vitamins

It is significant that the flow of bile and the nature of its constituents are profoundly influenced by diet Sugar inhibits the output of bile salts and diminishes the total quantity of bile The feeding of meat, on the other hand leads to an increased flow of bile with an increased amount of bile salts while it decreases the output of bile pigments

The *pathologic features* of the several chronic destructive and degenerative processes which involve the parenchyma of the liver are, according to Snell,[41] essentially the same whatever the type of injury The same fundamental changes, simple atrophy, fatty metamorphosis and focal necrosis, dominate the picture whether the origin of the disease is infectious obstructive or toxic Cirrhosis, which may result from repeated minor injuries, belongs in this category In all types of hepatic injury, therefore, the protection of the hepatic parenchyma, by dietary means or otherwise, involves always the same general problems

The *gallbladder* is apparently of little importance to the student of

*nutrition* Through the absorption of water and inorganic salts, it concentrates the hepatic bile that enters it to a density four to ten times that of the original At intervals, as the bile is needed, this structure empties the stimulus coming from the hormone cholecystokinin, produced by the action of fatty substances on the mucosa of the duodenum Active in producing this effect are such substances as cream, egg yolk olive oil and oleic acid

The gallbladder is of interest clinically only when it becomes infected or otherwise is injured Under such circumstances it no longer concentrates bile in the normal manner, but pours out a fluid which differs greatly in composition from the normal bile (See section on Diseases of the Gallbladder, p 472)

**Principles of the Diet** The liver plays an extremely important role in the storage and elaboration of nutritive substances and it provides these substances in available form as the tissues need them Its activities therefore are influenced profoundly by the food The arrangement of the diet should have two objectives, first to protect the liver against stress and second to enable this organ when damaged to function as efficiently as possible

For both objectives, protein comes first The elaboration of foodstuffs which takes place in the liver involves a great many intermediary steps each of which is controlled by appropriate enzymes These last are protein in character As one writer puts it Considered from a chemical view point, hepatitis and cirrhosis mean an intense breakdown of cell proteins, i e, of the enzyme systems Reversal of this breakdown or even inhibition of its progress, therefore, requires an increased supply of the building stones from which the enzyme systems are built up—amino acids and vitamins'[42] This explains why for the protection of the liver and for repair the diet should supply abundance of good protein Witness the experience of Messinger and Hawkins[43] who demonstrated that protein is most effective in protecting dogs against injury to the liver from arsphenamine, and that of Mann[44] who concludes that the liver is best prepared to meet stress when its stores of both carbohydrates and protein are ample

This is in sharp contrast to the older view which regarded the high carbohydrate low protein type of diet as the most suitable The results of this improvement in diet are graphic e g, in cirrhosis Patek and Post[45] at the end of the second year after the onset of ascites saw a survival of 45 per cent of their cases treated with the high protein diet and only 21 per cent of the controls In the patients so treated they also saw signs of general bodily improvement and presumptive evidence of retardation of the disease process More recently Morrison[47] has reported astonishingly good results from the use of his intensive combined method' of therapy This method includes a maximal protein high carbohydrate low fat diet in which protein is forced to a maximum of tolerance by three meat servings and at least six to eight glasses of skim milk and cottage cheese daily In addition, daily intravenous injections of whole liver extract (5 cc) fortified with high potency vitamin B complex in large dosage are given as well as oral

vitamin B complex, multivitamin capsules, methionine and choline This treatment was accompanied by a remission of all signs and symptoms in 64 per cent of cases without ascites as compared with remissions in only 10 per cent of control cases in the group with ascites remission recurred in 34 per cent of cases as compared with none in the corresponding control group

The diet for the patient with an impaired liver should, therefore, meet three specifications (1) it should be high in calories, providing 3000 to 4000 for the adult male, (2) it should contain a liberal amount of proteins of high biologic value and a high content of carbohydrate and (3) it should carry very little fat and only limited amounts of salt [47a] Radvin and his associates[48] advise that the calories be distributed as follows at least 20 per cent from protein, not over 6 per cent from fat, and 70 per cent from carbohydrate Before operation these authors give their patients protein largely in the form of casein, after operation they prefer calf s liver

Other nutritive substances, notably the lipotrophic substance choline are also used [48a] A deficiency of these substances sets the stage for the accumulation of fat in the liver, and since the presence of fat retards regeneration of liver cells to a remarkable degree, choline is believed to have special value in protecting the liver and in promoting recovery Methionine, because of its ability to supply the labile methyl groups used in the formation of choline is also lipotrophic and is sometime prescribed Since good proteins supply this substance in adequate amounts it has been suggested that it is unnecessary to supply it Steigmann [48b] however, from his studies of a large number of cases of cirrhosis of the liver concludes that, while a significant number of patients with cirrhosis do not respond to lipotrophic therapy in other cases clinically beneficial results are sometimes accomplished from such therapy Crude liver extract given intravenously in large doses two or three times a week for six months or longer was found by Labby and his associates[49] to be of great value in the treatment of cirrhosis

**Drugs** Drugs are believed to have no specific value in the treatment of hepatic disease [50] Reliance should be placed upon such increase in the resistance and restorative powers of the liver as can be produced by supplying abundant quantities of essential nutritive materials

## Cirrhosis

The properly nourished person, whatever the amount of alcohol consumed, will not, according to certain studies, acquire cirrhosis of the liver [51] Ratnoff and Patek[52] offer the suggestion that a balance of food factors may be essential to the integrity of the liver, but they add that the significance of these studies awaits further confirmation and clarification The hypoproteinemia with the reversed albumin globulin ratio from which patients with this disease suffer, by reducing the colloidal osmotic pressure of the blood favors transudation and thus contributes materially to the production of ascites It is reported that chronic injury to the liver may reduce the colloidal osmotic pressure as much as 50 per cent [52] These low values for plasma found in cirrhosis are at

tributed by Myers and Keefer not primarily to a diet low in protein or to poor absorption, but rather to loss of protein in the ascitic fluid, together with defective formation of plasma proteins In the effort to combat this condition, liberal amounts of protein should be included in the diet

As an additional measure for elevating the value for plasma proteins thiamine and possibly other vitamins should be given in large amounts Field[53] has seen marked relief of hypoproteinemia and edema follow the administration of thiamine in several types of nutritional edema and in cirrhosis of the liver Patek saw improvement definitely beyond expectation in a group of patients with cirrhosis who were fed a nutritious diet

**Table 105 Standard Diets for Cirrhosis Patients** (Patek and Post[15])

| Semiliquid Diet | | | | | |
|---|---|---|---|---|---|
| | | | Proteins | Fats | Carbohydrates |
| 7 A M | Milk | 200 cc | 6 | 8 | 10 |
| 8 A M | Cereal (Pablum) | 100 gm | 2 | 1 | 11 |
| | Sugar | 12 gm | | | 12 |
| | 20% Cream | 30 cc | 1 | 6 | 1 |
| | Eggs | 2 | 13 | 10 | |
| 9 A M | Orange juice | 200 cc | | | 18 |
| 10 A M | Eggnog | | | | |
| | Milk | 150 cc | 4 5 | 6 | 7 5 |
| | Egg | 1 | 6 5 | 6 | |
| | Sugar | 10 gm | | | 10 |
| | Brewers' yeast | 25 gm | 12 5 | 0 5 | 8 5 |
| 11 A M | Cream soup | 200 cc | 6 | 14 | 15 |
| | Mashed potatoes | 100 gm | 2 | 6 | 15 |
| | Butter | 10 gm | | 8 5 | |
| | Puréed vegetables | 100 gm | | | 9 |
| | Orange juice | 200 cc | | | 18 |
| 12 noon | Cocomalt | 200 cc | 6 | 10 | 20 |
| 2 P M | Eggnog | 200 cc | 11 | 11 | 17 5 |
| 3 P M | Orange juice | 200 cc | | | 18 |
| 4 P M | Cereal (Pablum) | 100 gm | 2 | 1 | 11 |
| | Sugar | 12 gm | | | 12 |
| | Cream, 20% | 30 cc | 1 | 6 | 1 |
| | Jello | 100 gm | 1 | | 18 |
| | Cream, 20% | 30 cc | 1 | 6 | 1 |
| | Orange juice | 200 c c | | | 18 |
| 5 P M | Cocomalt | 200 cc | 6 | 10 | 20 |
| 6 P M | Eggnog | 200 cc | 11 | 11 | 17 5 |
| | Brewers' yeast | 25 gm | 12 5 | 0 5 | 8 5 |
| 7 P M | Eggnog | 200 cc | 11 | 11 | 17 5 |
| | Grand total | | 116 | 131 | 315 |

*Calories, 2903*

**Table 105 Standard Diets for Cirrhosis Patients—*(Continued)***

Solid Diet

| | | Proteins | Fats | Carbohydrates |
|---|---|---|---|---|
| **Breakfast** | | | | |
| Fruit, 18% | 1 serving | | | 18 |
| Cooked cereal or | 200 gm | 4 | 2 | 20 |
| Prepared cereal | 30 gm | | | |
| Sugar on cereal | 12 gm | | | 12 |
| Eggs | 2 only | 13 | 10 | |
| Milk | 200 cc | 6 | 8 | 10 |
| Toast | 60 gm | 4 | 1 | 30 |
| Butter | 20 gm | | 17 | |
| Coffee | | | | |
| Cream, 20% | 30 cc | 1 | 6 | 1 |
| Sugar | 12 gm | | | 12 |
| 9 A.M. Brewers' yeast | 25 gm | 12.5 | 0.5 | 8.5 |
| Milk | 150 cc | 4.5 | 6 | 7.5 |
| Sugar | 12 gm | | | 12 |
| **Dinner** | | | | |
| Meat, medium fat | 100 gm | 17 | 20 | |
| Vegetables, 5% | 100 gm | 1 | | 4 |
| Vegetables, 10% | 100 gm | 2 | | 9 |
| Vegetables, 20% | 100 gm | 3 | | 19 |
| Bread | 30 gm | 2 | | 15 |
| Butter | 20 gm | | 17 | |
| Dessert (cake, pudding) | 1 serving | 5 | 8 | 25 |
| Milk | 200 cc | 6 | 8 | 10 |
| Coffee | | | | |
| Cream, 20% | 30 cc | 1 | 6 | 1 |
| Sugar | 12 gm | | | 12 |
| 2 P.M. Brewer's yeast | 25 gm | 12.5 | 0.5 | 8.5 |
| Milk | 150 cc | 4.5 | 6 | 7.5 |
| Sugar | 12 gm | | | 12 |
| 3 P.M. Orange juice | 200 cc | | | 18 |
| **Supper** | | | | |
| Soup (Julienne) | 200 cc | 4 | | 4 |
| Meat, medium fat | 100 gm | 17 | 20 | |
| Vegetables, 5% salad | 100 gm | 1 | | 4 |
| Vegetables, 20% | 100 gm | 3 | | 19 |
| Bread | 30 gm | 2 | | 15 |
| Butter | 20 gm | | 17 | |
| Milk | 200 cc | 6 | 8 | 10 |
| Fruit, 18% | 100 gm | | | 18 |
| Tea | | | | |
| Cream, 20% | 30 cc | 1 | 6 | 1 |
| Sugar | 12 gm | | | 12 |
| 7 P.M. Milk | 200 cc | 6 | 8 | 10 |
| Grand total | | 139 | 175 | 365 |

Calories, 3591

plus vitamin supplements In a report of additional experiments this investigator and Post[45] emphasized the evident need for the vitamins of the B complex in their patients and recommended the administration of brewers yeast The use of choline and other lipotrophic substances is possibly unnecessary when an abundance of protein is given More recently emphasis[47] has been laid on the value of daily injections of a solution of crude liver extract given in large doses (5 cc) The hemorrhage which is prone to occur in cirrhosis, other than that which comes from rupture of an esophageal varix, is believed to be due to lack of prothrombin This in turn is apparently due in part to lack of vitamin (failure of absorption of the vitamin due to the absence of bile) plus impaired formation of prothrombin by the diseased liver In the effort to prevent cholemic bleeding, therefore, the patient may be fed bile and concentrates of vitamin K

**Diet** The diet in cirrhosis of the liver should provide adequate amounts of carbohydrate, liberal amounts of protein, very little fat and an abundance of vitamins, notably those of the B complex By supplementing such a diet with 50 gm daily of dried brewers yeast Patek and Post[45] were able to accomplish unusually good results The diets prescribed by these investigators provided 2900 to 3600 Calories and carried 116 to 135 gm of protein (of which 25 gm was in the form of yeast) and 316 to 365 gm of carbohydrate

An excessive amount of fat in the diet is detrimental The authors just quoted express the prevailing opinion when they state that any considerable increase of fat in the liver, even though produced by physiologic means, impairs the functional capacity of this organ The fats of the diet, therefore, should be restricted

Sodium retention is believed to be one of the factors operative in the accumulation of ascitic fluid, and the restriction of this electrolyte is advised It should be borne in mind, however, that the studies of Holly and McLester[53a] would indicate that the rigid restriction of sodium chloride combined with the use of mercurial diuretics may produce a salt depletion syndrome of serious proportions

An abundant intake of vitamins is probably helpful in fortifying the liver against stress as well as in repairing damage already done Vitamin deficiency probably leads eventually to functional and structural impairment of the liver and, conversely, impaired liver function leads to poor absorption and faulty utilization of vitamins It is important therefore, that the food provide abundant vitamins particularly vitamins A and K and those of the B complex Vitamin A should be obtained preferably from animal foods (see p 66) If bile is lacking in the intestinal tract bile salts should be given In the experiments of Patek and Post dried brewers yeast was given both because of its richness in the B complex and because of the excellence of its proteins Crude liver extract given parenterally is also of value

To protect the liver, then the patient should receive a diet providing 2800 to 3000 Calories of which approximately 75 to 80 per cent should come from carbohydrate and 18 to 20 per cent from protein The vitamins and a part of the protein should come from brewers yeast if

yeast is not prescribed, crude liver extract should be administered parenterally The food should be simple, of sufficient variety and attractively served

The following high protein menus were prepared by Berger[54] and used successfully in the treatment of disease of the liver in the Mediterranean theater of operations of the United States Army The large protein figure was reached by giving each day a minimum of 1 pound of lean beef and 1 quart of prepared skim milk The latter is made by adding 50 gm of skim milk powder to 200 cc of water which after being thoroughly beaten is strained and iced When desirable, the milk can be flavored with a chocolate sauce made of cocoa, sugar and water The author estimates that these diets contain approximately 225 gm of protein, 500 gm of carbohydrate, 75 gm of fat and 3500 Calories

**Table 106 High Protein Menus (Berger[54])**

I

Breakfast
- Fresh orange juice
- Oatmeal skim milk sugar
- Hot cakes butter maple syrup
- Coffee skim milk sugar
- Skim milk

Dinner
- Swiss steak
- Baked potato
- Boiled cabbage
- Orange and date salad
- Bread butter jam
- Maple ice cream
- Coffee skim milk sugar
- Skim milk

Supper
- Roast beef natural gravy
- Baked navy beans
- Cold tomatoes
- Bread butter jam
- Baked custard rice pudding fruit sauce
- Skim milk

Evening Nourishment
- Chicken salad sandwich
- Cocoa

II

Breakfast
- Canned grapefruit
- Cornflakes skim milk sugar
- Soft cooked egg
- Toast butter jam
- Coffee skim milk sugar
- Skim milk

Dinner
- Hamburger
- Hash browned potatoes

Supper
- Hot roast beef sandwich, gravy
- Succotash
- Carrot strips
- Bread, butter, jam
- Tangerines, dates
- Skim milk

Evening Nourishment
- Salmon salad sandwich
- Cocoa

*VII*

Breakfast
- Pineapple juice
- Cornflakes, skim milk, sugar
- Hot cakes, butter, maple syrup
- Coffee, skim milk, sugar
- Skim milk

Dinner
- Baked meat balls
- Spaghetti, tomato sauce
- Cole slaw
- Bread, jam
- Tutti frutti ice cream
- Coffee, skim milk, sugar

Supper
- Steak
- Baked potato
- Savory onions
- Waldorf salad
- Bread, butter, jam
- Blanc mange, caramel sauce
- Skim milk

Evening Nourishment
- Split pea soup
- Toast, butter
- Skim milk

VIII

Breakfast
- Fresh apple sauce
- Oatmeal, skim milk, sugar
- Soft cooked egg
- Toast, butter, jam
- Coffee, skim milk, sugar
- Skim milk

Dinner
- Roast chicken, gravy
- Mashed potatoes
- String beans
- Hot rolls, butter, jam
- Fresh fruit
- Skim milk

Supper
- Stuffed beef rolls
- Creamed carrots and peas
- Fennel
- Bread butter jam
- Fruit Jello
- *Skim milk*

Evening Nourishment
- Steak sandwich
- Mustard sliced onions
- Coffee skim milk sugar
- Skim milk

**Table 107 A High Protein Beverage** (Bauman[55])

The method of preparation is simple It consists in mixing milk powder (Dryco) gradually with frozen egg white which has been beaten until foamy (but not dry) with [illegible] Filtration

[illegible] in be forti fied with vitamin concentrates or cream if added Calories are required The day s supply is prepared in the morning and kept cool in the refrigerator When served each glass may be sweetened with sugar and flavored with vanilla chocolate coffee malt extract or molasses

| Ingredient | Grams | Carbohydrate (gm) | Protein (gm) | Fat (gm) | Calcium (gm.) | Phosphorus (gm.) | Iron (Mg) | Vitamin A (International Units) | Thiamine (Mg) | Vitamin C | Riboflavin (Mg) | Vitamin D (International Units) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Milk | 625 | 31 | 21 | 25 | 0 73 | 0 58 | 1 3 | 1 000 | 0 30 | — | 1 38 | 3 30 |
| *Dryco* | *150* | *69* | *48* | *18* | *1 50* | *1 22* | — | *3 150* | *0 54* | — | — | 495 |
| Egg white | 300 | 2 | 32 | — | 0 04 | 0 05 | 0 3 | — | — | — | 0 68 | — |
| Total (119 Calories) | — | 102 | 101 | 43 | 2 27 | 1 85 | 1 6 | 4,150 | 0 84 | — | 2 06 | 498 |
| 1 glass 200 cc, *240 Calories* | — | *20* | *20* | *9* | *0 45* | *0 37* | *0 3* | *830* | *0 17* | — | *0 41* | *100* |

*Measures of food used* Milk *2½ cups*
Egg whites (frozen) 1¼ cups
Dryco 1⅞ cups

## Infectious Hepatitis (Catarrhal Jaundice)

Infectious hepatitis is an old disease which, because of its increased frequency during World War II, has become the subject of widespread clinical interest It may occur sporadically or in epidemics, it is probably the epidemic form of what was formerly called 'catarrhal jaundice Its cause is not definitely known, but it is believed to be due to a filtrable virus The agent can be recovered from the blood and feces of patients in an early stage of the disease, and from the ingestion of this material human volunteers have become infected It is believed to be

spread by the intestinal oral route Epidemics have been traced to water, food and milk [56]

Because of differences in the period of incubation and the manner in which the infection is acquired a distinction is drawn between infectious hepatitis and homologous serum hepatitis The latter disease is seen in persons who have been infected through the parenteral innoculation of human blood products—through the use of transfusions convalescent serums or vaccines The two diseases are in all probability related

The predominant symptoms of the hepatic insufficiency, which often accompany infectious hepatitis and other diseases of the liver, are jaundice and hepatomegalia Associated with these symptoms, however, are others which, according to Lichtman,[57] fall largely in the following categories (1) a clinical picture simulating a generalized infection (2) an enteric form in which gastrointestinal disturbances predominate, (3) neurologic neuropsychiatric forms, (4) a nutritional deficiency state or (5) cases marked by the clinical manifestations of portal failure

Pathologically, infectious hepatitis is characterized by the simultaneous occurrence of inflammatory and degenerative changes in the hepatic parenchyma In fatal cases there is a massive autolytic necrosis of liver tissue which may be accompanied in some areas by extensive regeneration [58]

The treatment of this disease, according to Capps and Barker,[59] should consist in bed rest, diet and the avoidance of additional factors injurious to the liver They report that those patients who were undernourished at the time of the onset of the disease were likely to have severe cases and that in underweight patients who failed to gain weight the course of the infection was usually protracted They believe that diet may become a dominating factor when malnutrition is present or when there is prolonged anorexia, in the latter cases they suggest the use of plasma or amino acids by vein

These physicians recommend a high protein high carbohydrate diet but advise only moderate restriction of fat For the average case they recommend a diet of protein, 200 gm, fat, 65 gm, and carbohydrate 300 gm They use skim milk powder and cottage cheese to enhance the protein value of the diet and only enough butter and cream to make the food palatable (See Table 108)

### Syphilis of the Liver

Syphilis of the liver is probably a much more frequent form of hepatic injury than is commonly believed The diet advised for diseases of the liver in general is appropriate, the degree of restriction depending upon the extent of parenchymal impairment In cases of extensive involvement the treatment designed for patients with hepatic insufficiency is applicable

### Tumors, Abscesses and Cysts of the Liver

Tumors, abscesses and cysts of the liver demand the diet advised for hepatic diseases in general The extent of the restriction should depend largely on the degree of functional impairment

**Table 108 Diet in Infectious Hepatitis** (Berger[44])

| Breakfast | Weight (*Gm*) | Approximate Measure | Prot (*Gm*) | Fat (*Gm*) | Carbo (*Gm*) | Calories |
|---|---|---|---|---|---|---|
| Fresh orange juice | 200 | one 8 oz glass | | | 20 0 | 80 |
| Whole wheat cereal | 30 | ¾ cup | 3 5 | 0 6 | 22 7 | 110 |
| Soft-cooked egg | 50 | 1 | 6 4 | 5 8 | 0 4 | 79 |
| Toast | 70 | 2 slices | 6 0 | 2 0 | 36 0 | 186 |
| Butter | 10 | 1 pat | 0 1 | 8 1 | | 73 |
| Jam | 40 | 2 tbsp | 0 2 | 0 12 | 28 4 | 116 |
| Coffee—sugar | 39 | 3 tbsp | | | 39 0 | 156 |
| Skim milk | 250 | one 8 oz glass | 18 0 | 0 5 | 26 0 | 181 |
| *Total* | | | *34 2* | *17 12* | *172 5* | *981* |
| Dinner | | | | | | |
| Choice steak | 240 | 1 large | 40 6 | 14 4 | | 292 |
| Mashed fresh potatoes | 100 | ½ cup | 4 3 | 1 1 | 22 4 | 117 |
| Savory string beans | 100 | ½ up | 1 0 | 0 1 | 3 3 | 18 |
| Fruit salad | 130 | ½ cup | 0 4 | 0 3 | 26 1 | 108 |
| Fruit salad dressing | | | | | | |
| Bread | 70 | 2 slices | 6 0 | 2 0 | 36 0 | 186 |
| Butter | 10 | 1 pat | 0 1 | 8 1 | | 73 |
| Jam | 40 | 2 tbsp | 0 2 | 0 12 | 28 4 | 116 |
| Butterscotch pudding | 130 | ½ cup | 4 7 | 0 5 | 35 5 | 165 |
| *Skim milk* | *250* | *one 8 oz glass* | *18 0* | 0 5 | *26 0* | *181* |
| Total | | | 75 3 | 27 12 | 177 7 | 1256 |
| Supper | | | | | | |
| Coast beef—natural gravy | 240 | 1 large serving | 40 6 | 14 4 | | 292 |
| Rumplings | 120 | 3 medium | 7 6 | 1 1 | 24 6 | 139 |
| Dreamed peas | 100 | ½ cup | 5 6 | 0 26 | 13 4 | 78 |
| Carrot strips | 100 | 1 large | 1 2 | 0 3 | 9 3 | 45 |
| Bread | 70 | 2 slices | 6 0 | 2 0 | 36 0 | 186 |
| Fresh butter | 10 | 1 pat | 0 1 | 8 1 | | 73 |
| Jam | 40 | 2 tbsp | 0 2 | 0 12 | 28 4 | 116 |
| Sliced pineapple | 100 | 1 slice | 0 4 | 0 1 | 14 5 | 60 |
| Skim milk | 250 | one 8-oz glass | 18 0 | 0 5 | 26 0 | 181 |
| Total | | | 79 7 | 26 88 | 152 2 | 1170 |
| Evening Nourishment | | | | | | |
| Vegetable soup | 175 | 1 cup | 5 75 | 1 5 | 14 5 | 94 |
| Toast | 70 | 2 slices | 6 0 | 2 0 | 36 0 | 186 |
| Butter | 10 | 1 pat | 0 1 | 8 1 | | 73 |
| Skim milk | 250 | one 8 oz glass | 18 0 | 0 5 | 26 0 | 181 |
| Total | | | 29 85 | 12 1 | 76 5 | 534 |
| Grand total | | | 219 05 | 83 22 | 578 9 | 3941 |

## DISEASE OF THE GALLBLADDER

The gallbladder is a relatively unimportant appendage and becomes of clinical interest only when it is infected, when it harbors a stone which causes trouble or perhaps when it is the site of a malignant growth. The presence of a stone is not in itself of great moment unless the irritation which it causes leads to infection or unless it impedes the flow of bile. Since cholelithiasis, however, usually means cholecystitis as well, operation for the removal of the stone and for drainage or removal of the gallbladder is often advisable. This is not the place to discuss the technic of drainage of the gallbladder according to the method of Lyon or the benefits to be derived therefrom. However, I know of no experimental data which would lead one to believe that in this manner the flow of bile can be increased; and in my own experience I have been unable to find, after discounting the psychic element, that this procedure is of clinical value.

The diet for patients with cholecystitis is one which would be suitable for patients with chronic or subacute gastritis. In spite of the fact that fats and fatty acids are the foods most active in emptying the gallbladder, clinical experience has taught that it is inadvisable to give high-fat diets to patients with disease of this organ; they are as a rule more comfortable upon a low-fat regimen. Milk, cereals, milk toast, toast, zwieback, cooked fruits, rice and mashed potatoes should be taken during the acute stage. Occasionally eggs are well borne from the beginning. When the inflammatory reaction is less acute, tender meats and the simpler vegetables may be added. All highly seasoned foods, fried foods and pastries should be avoided.

**Table 109. Menus for Patients with Disease of the Gallbladder**

I.

7:00 A.M. (or before)
    Hot lemon water

Breakfast
    Average helping of farina; cream and sugar
    1 coddled egg
    2 small popovers; ½ teaspoonful of butter; preserves
    Cocoa or milk

10 30 A.M.
    1 glass of milk; apple sauce

Dinner
    Small helping of tenderloin steak (about 2 ounces)
    *Small baked potato*
    Average helping of purée of spinach
    Average helping of Snow pudding
    1 glass of milk

4:00 P.M.
    1 cup cocoa; 2 butter wafers

Supper
    1 slice of creamed toast
    Well cooked and mashed carrots
    2 halves of canned peaches
    1 glass of milk

Bedtime
1 glass of milk, 3 tablespoonfuls of boiled custard

II

7 00 A M (or before)
Hot fruit water

Breakfast
[illegible]

10 30 A M
1 glass of milk

Dinner
Small helping of broiled white fish
2 heaping tablespoonfuls of creamed potatoes
Average helping of purée of green beans
1 slice of dry toast
Baked apple without skin and core
1 glass of milk

4 00 P M
1 glass of milk, 3 small crackers

Supper
1 egg omelet
Purée of baked squash
2 small plain muffins 1 teaspoonful of jelly or honey
1 glass of milk

Bedtime
1 glass of milk

III

7 00 A M (or before)
Hot lemon water

Breakfast
Average helping of Cream of Wheat cream and sugar
1 scrambled egg
2 small slices of toast apple sauce
Cocoa or milk

10 30 A M
1 glass of milk

Dinner
1 medium sized very tender broiled lamb chop (no fat)
1 tablespoonful of steamed rice 1 teaspoonful of butter
Average helping of tapioca pudding
Sliced tomato (no dressing)
1 slice of toast
1 glass of milk

4 00 P M
1 glass of milk with crackers

Supper
Average helping of Ralston breakfast food whole milk
Creamed asparagus tips on toast
2 tablespoonfuls of Floating Island
1 glass of milk

Bedtime
Baked custard 1 glass of milk

## DISEASES OF THE PANCREAS

The dietary regulation of pancreatic disease depends on the extent and nature of the functional disturbance rather than on the character of the disease itself. Since this organ is concerned with the production of digestive ferments, anything which interferes with this function will also interfere in greater or less degree with the digestive processes of the intestinal tract. Therefore, in constructing a diet for the patient with pancreatic disease, the chief question concerns the resulting digestive impairment. Numerous methods have been devised for determining the degree of failure of the several pancreatic ferments. The ferment activity of the duodenal contents obtained through a duodenal tube is believed to give information of value; also the amount of trypsin and of diastatic ferments in the feces can be determined in vitro with a fair degree of accuracy by appropriate tests. The tests for urinary diastase are of doubtful value. Kashiwado's[60] modification of Schmidt's nucleus test is probably of some value. The most reliable and perhaps the easiest method, however, of ascertaining the degree of functional impairment of the pancreas is to give the test diet of Schmidt and to examine the feces after the manner recommended by him. The necessity for a special test diet has been questioned because sufficient information can be obtained from the examination of almost any specimen of feces. I am sure, however, that more uniformly reliable conclusions can be drawn from the feces when the test diet is used. This diet is given in detail on page 432.

The manner in which all three classes of foodstuffs are dealt with in the intestine should be determined, and to this end both macroscopic and microscopic examinations should be made. The most characteristic evidence of pancreatic insufficiency, though it is by no means always present, is the large, soft, light-colored stool containing large amounts of undigested fat *(steatorrhea)*; especially characteristic is the "butter layer" of partially hardened fat which sometimes covers the fecal mass. Under the microscope, droplets and balls of fat, present in much greater amounts than in the normal stool, are easily recognized Evidence of poor tryptic action, especially if there is gastric anacidity, may appear as easily recognizable muscle fibers with distinct striations. If the gastric digestion is normal, but tryptic digestion fails, muscle remains can usually be recognized under the microscope as fine splinter-like particles. The presence of undigested muscle fibers in the feces *(creatorrhea)* after the test meal, in the absence of diarrhea, is always suggestive of pancreatic disease. To explain the variability of the signs of pancreatic insufficiency, Schmidt stated that when pancreatic disease follows cholecystitis, there is early impairment of the fat-digesting function, but if it follows disease of the stomach, evidences of protein indigestion will predominate. Disturbances of carbohydrate digestion are not always apparent, although undigested starch granules are often encountered. The presence of glycosuria or even of a lowered dextrose tolerance may be an additional link in the chain of evidence pointing to the disease of the pancreas.

**Functional Disturbances** Such disturbances of the pancreas independent of organic disease and analogous to functional gastric disturbances are believed to occur occasionally *(achylia pancreatica)* The dietary regulation in such cases should depend on the extent and nature of the digestive failure as shown in the feces and should follow in general that of chronic pancreatitis Spontaneous hypoglycemia is a symptom complex sometimes attributable to increased insulogenic function the salient features of which are a low blood sugar content weakness and in cases of severe involvement coma and convulsions This was discussed in an earlier chapter

**Acute Pancreatitis** This ranges in severity from the mildest usually unrecognized inflammatory reaction to severe illness of the greatest gravity The former condition requires only such dietary regulation as would be suggested by the digestive disturbance indicated by the feces At the other extreme the profound collapse with great abdominal pain and the rapidly fatal course of the disease may prevent the use of food except perhaps in the form of a little broth milk and fruit juices

**Necrosis of the Pancreas** This is an extremely serious and usually fatal form of pancreatitis If the patient s condition will permit surgical treatment comes first As a rule no food is permissible because of the complicating peritonitis but in some instances liquids in the form of milk bouillon and strained gruels may be given in small amounts

**Chronic Pancreatitis** Chronic pancreatitis is always subject to dietary regulation for it is possible in this way to add greatly to the comfort of the patient and perhaps to promote his recovery The nature of the disease with which the pancreatitis may be associated should in some measure influence the diet It is often the sequel of cholecystitis or cholelithiasis and not infrequently there is achylia gastrica Maimon and his associates[61] have recently described a chronic recurrent pancreatitis which is accompanied most often by recurrent bouts of severe pain in the upper abdomen without definite physical findings The association of diabetes with pancreatitis naturally demands a dietary regimen suitable for the former Ulcer of the duodenum or a perforating gastric ulcer if present should obviously dictate the type of dietary regulation

The chief indication in the diet of patients with chronic pancreatitis is rigid reduction of the intake of fat Butter cream fat meats oil dressings and similar foods should be avoided As a rule it is not necessary to skim the milk but sometimes this may be necessary The taking of meats should be limited if meat fibers are found in the feces in appreciable amounts While moderate restriction of the intake of other forms of albumin also is desirable it goes without saying that the patient should be given enough protein to meet his minimal metabolic needs perhaps a gram per kilogram of body weight daily The protein of milk is usually well borne and for this reason milk should take a prominent place in the diet Eggs may also be given in moderate amount (two eggs daily) they should be taken soft boiled or poached rather than raw The various forms of predigested albumin which are on the market are of doubtful value The diet should consist in large

part of gruels, toast preserves and other easily digested carbohydrates provided fermentative dyspepsia is not a prominent feature Fruits and the coarser vegetables should be avoided except in thoroughly cooked forms, such as compotes and purées Fruit juices such as orange juice may be taken as well as baked apples, stewed prunes and similar fruits

Occasionally a moderate degree of enteritis develops, no doubt be cause of the presence in the feces of poorly emulsified fats and irritating fatty acids This complicates the picture and demands even greater care in the selection of the diet In such cases the diet should be limited largely to milk, cereals and milk toast

*This is not the place to discuss in detail other forms of treatment* It is appropriate to say, however, that the arrangement of the diet is simplified when digestion is aided by the use of pancreatin or some similar pancreatic preparation and when, in the case of achylia gastrica liberal amounts of hydrochloric acid are given

**Patients with Carcinoma, Cyst and Other Tumors** When a tumor leads to an excessive output of insulin the symptoms are those of spon taneous hypoglycemia (see p 310) The same diet is appropriate but in case of tumor the dietary treatment accomplishes little Operation offers the only chance of relief

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# 22

## *Febrile Diseases*

The food of the patient with fever should meet two major specifications (a) it should contain no article which is harmful and (b) it should be sufficient in amount to cover the metabolic needs It is best to consider the first of these specifications separately with each type of fever The second can be discussed with regard to fever in general for with a few exceptions the metabolic needs are the same no matter what the type of fever they depend on the degree of temperature and the duration of the illness rather than on the cause of the fever

For the purpose of this book febrile diseases can be considered in the following manner first the nature of fever then in detail one typical fever typhoid and finally the incidental nutritive needs in the other febrile diseases

### THE NATURE OF FEVER—METABOLISM

Fever is due to a disturbance in the balance normally maintained between heat production and heat elimination Abnormal heat production alone as was demonstrated by Rubner [1] will not cause fever heat elimination also is concerned This and many other problems relating to fever were clarified by the brilliant work of the investigators of the Russell Sage Institute of Pathology at Bellevue Hospital who showed that while there is increased heat production during fever this increase is no greater than that experienced during moderate exercise and that the rise in body temperature is due primarily to interference with heat elimination

By what means is this accomplished? What is the mechanism which preserves body temperature at an almost constant figure the disturbance of which leads to fever? Du Bois[2] states that while there is a great deal of local adjustment in various parts of the body the finer control seems to be in the hypothalamus This center apparently serves as a thermoregulator which is normally set at 37° C but which under certain conditions notably during bacterial invasion becomes adjusted to a higher level Impulses proceeding from this center stimulate heat production by chemical means and as long as the heat loss remains the same the temperature rises Water balance no doubt plays a contributory role increased passage of water from the capillaries into the tissues probably leads to an impairment of the circulation of the skin and as a result there is curtailment of heat loss When the body has been warmed to the new level a balance between

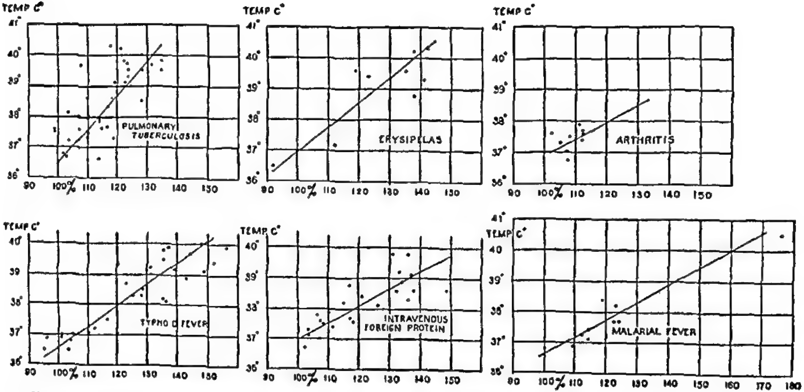


Fig 13 Relationship of basal metabolism to temperature in various fevers The ordinates represent rectal temperature in degrees centigrade, the abscissas, the metabolism expressed in percentages of the average normal, e g, 150 equals 50 per cent above the average. Each dot represents a calorimeter experiment of from one to three hours at the given temperature (Du Bois 3b)

heat production and heat loss is again established Later, as the toxic or other influences which have set this center at the higher level are overcome, a new adjustment at the normal level is made, and as physical regulation brings about increased heat loss, the temperature falls

The increase in metabolism which accompanied the fevers studied by the investigators of the Russell Sage Institute[3] was found, except in pulmonary tuberculosis, to parallel with considerable uniformity the rise in temperature For each degree centigrade of rise in body temperature, there was a 13 per cent increase in heat production (7 2 per cent increase for each degree Fahrenheit) The same coefficient of increase was seen by Sturgis[4] in a patient with exophthalmic goiter who had tonsillitis These figures give testimony to the closeness with which chemical changes in the body follow the laws which govern reactions in the test tube, and Van t Hoff s law seems to hold good here also "With a rise in temperature of 10 degrees centigrade the velocity of chemical reactions increases between 2 and 3 times" Thus an increase in temperature of 3 degrees (from 37° to 40° C ) should, according to this law, be accompanied by a metabolic increase of 30 to 60 per cent, which in practice has been found to be the case It is relatively easy, as was pointed out by Du Bois [3b] to determine from these figures the metabolism of a patient with fever Calculate the normal basal rate and then add 13 per cent for each degree of elevation of temperature, when there is great toxic destruction of body tissues, add another 10 per cent, if the patient is very restless add yet another 10 per cent or even as much as 30 per cent

Protein metabolism is greatly increased in the fevers because of the destruction of protein by bacterial invasion Although hyperthermia will cause increased destruction of protein, the extent of protein destroyed in fever actually bears little relation to the height of the temperature it is more directly dependent on the grade of the infection It was once thought that nitrogen balance could not be secured in severe infections, but Shaffer and Coleman[5] demonstrated that this can be done if the total caloric intake is large Their diets provided 3500 to 5200 Calories

Carbohydrate metabolism is influenced by fever in that the reserves of carbohydrate are burned first, the liver becomes glycogen poor, and the stores of glycogen elsewhere are exhausted

For further information concerning metabolism in the various fevers the reader is referred to the work of Du Bois and his associates at the Russell Sage Institute, reports of which are given in their articles entitled "Clinical Calorimetry,' published in the *Archives of Internal Medicine* The reader is also referred to the monograph on heat regulation by Barbour,[6] and to a paper by Du Bois[2] and to Du Bois'[7] monograph

## TYPHOID

**Metabolism** Like other fevers, typhoid causes an increase of about 13 per cent in metabolic rate for each rise of 1 degree centigrade in body temperature This increase during the height of the fever, accord

ing to the investigators of the Russell Sage Institute, may be as much as 23 to 44 per cent It is interesting that the youthful patient with typhoid shows merely the same metabolic rate per square meter of body surface as the adult In explanation of this absence of an increment due to growth Du Bois offers the suggestion that in typhoid a summation of the stimuli of growth and fever does not occur and that in the youthful patient the latter possibly takes the place of the former

Carbohydrate metabolism proceeds as in health There is a distinct difference in the respiratory quotients of patients kept on the old type of starvation diets and those given the modern high caloric diet the former show a relatively low respiratory quotient (0 76) which approaches that of starvation while the latter give a relatively high quotient (0 87), even higher than that of the normal subject The quotient in the latter case is especially high in the early weeks of convalescence (0 95 to 1 00), indicating that at this time there is retention of large quantities of carbohydrate and perhaps even storing of carbohydrate in the form of fat Fat metabolism does not differ from that in health except that on a starvation diet the patient is forced to draw on his stores of body fat

Protein metabolism during fever differs from that in health in two respects (a) there is great protein destruction and (b) the metabolism does not experience from protein its usual specific dynamic action The increased destruction of protein in this disease is an established fact but its exact cause is not entirely clear it is usually ascribed to the toxic action of the infecting agent In spite of this increased destruction of protein nitrogen equilibrium can be maintained as was first demonstrated by Shaffer and Coleman by a diet which supplies sufficient protein and a superabundance (3500 to 5000) of Calories The absence of the specific dynamic action of protein can probably be explained on the assumption that the fever impulse takes its place [8] This is of clinical importance in that it demonstrates that there is no basis in fact for the fear of the older clinicians that a liberal intake of protein will stimulate the fever It has no such influence Thus the knowledge of the protein metabolism of typhoid can be summarized as follows (1) The destruction of protein is about three times the wear and tear of health and to cover this the patient should be given not only a liberal amount of protein but also a total caloric intake from 50 to 100 per cent in excess of that necessary in health (2) The giving of additional protein and other food does not in itself increase the fever

**Pathologic Anatomy** Typhoid is a general infectious disease the chief manifestations of which are in the intestine it is not an intestinal disease The early involvement of Peyer s patches with their subsequent coagulative necrosis and resulting ulcerations is the outstanding pathologic feature In addition there are extensive changes in the liver with disease of the gallbladder and bile passages All of this interferes with digestion but strange to say to a much less extent than the pathologic anatomy would lead one to expect In spite of all these changes food is digested and absorbed remarkably well

**Diet** The advantages of a high caloric diet as opposed to the semi

starvation regimen long in vogue, were first pointed out by Shaffer,[9] in 1908, and discussed further by Shaffer and Coleman[5] and again by Coleman,[10] in 1909, as the result of which came the general recognition that a radical change in the method of feeding these patients was necessary Coleman demonstrated the advantages of a more radical diet in cases of typhoid and advised for a patient of 150 pounds (68 kilo grams) an intake of about 4000 Calories He stated that in his exper ience best results had been obtained with a diet containing from 60 to 80 Calories per kilogram of body weight or about 4000 to 5000 Calories daily To one patient he gave 100 Calories per kilogram per day, or a a total of about 6000 Calories His experience with this diet was emi nently satisfactory, the patients were not so ill as formerly, they were more comfortable, and the duration of the disease was shorter He expressed the opinion that a caloric intake which is a little less than that used by him would be adequate, estimating as the approximate ideal for these patients an intake of 40 Calories per kilogram of body weight It was subsequently shown by Du Bois and other investigators at the Russell Sage Institute[11] that these large amounts of food were as readily absorbed in typhoid as in health

In 1917 Coleman[12] discussed at length his further experience with this high caloric diet He found that the total duration of the disease in many instances was shortened and that a long convalescence was avoided Tympanites and diarrhea were not nearly as frequent as formerly There was almost complete absence of the severe nervous symptoms Great loss of weight was avoided, and complications such as hemor rhage and perforation were less frequent The mortality of a control group of milk fed patients was 17 per cent, while that of the patients given the more liberal diet was 4 5 per cent (222 patients were in cluded in each group) The conclusions reached by Coleman at that time still hold good (1) The older diets for typhoid did not furnish sufficient energy for metabolic exchanges (2) The amount of food can be determined only by the patient s individual needs The clinical guides are the weight of the patient and the state of his appetite In the early stages it is always difficult to give more than 3000 Calories a day In the "steep curve period" and in convalescence, patients take readily from 4000 to 6000 Calories a day (3) The patient cannot take all the food he requires he should be given all he can digest and absorb (4) Carbohydrates should furnish the greater part of the diet The daily intake of protein should not be below 62 gm or greatly exceed 94 gm A diet rich in fat may be taken with benefit In some instances fat has furnished from one third to one half of the total energy of the food (5) A high caloric diet has apparently modified the course of the disease, shortened convalescence and reduced the mortality

In no other disease, except in true deficiency states, has the value of adequate nourishment been demonstrated in so graphic a manner I can testify to the deplorable state of those early patients whose food was restricted to milk and broth and to the sharp contrast shown by the patients who in more recent years have been given the high caloric diet Formerly, the parched tongue, severe diarrhea, abdominal dis

tention, great emaciation, restlessness, carphology, subsultus tendinum, muttering delirium and other distressing nervous symptoms often combined to make up the clinical picture Now one sees little of that Indeed, thanks to improved sanitation, this disease is no longer the problem it was in the days of the Spanish American War

*Selection of Food* The object of the diet in this disease should be to meet in full the patient's caloric requirements, but it is not necessary to prevent all loss of protein This contemplates a daily intake of from 40 to 50 Calories per kilogram, in which is included from 1 to 1 5 gm of protein per kilogram and carbohydrate to the extent of 350 to 500 gm Feedings should be at intervals of two or three hours Large amounts of food at one time are not well borne

Milk should furnish the basis of the diet The number of persons who are allergic or who have an idiosyncrasy for milk is small, and a great many of those who say that they cannot take this food can with patience be taught to like it Milk does not as a rule increase abdominal distention, nor does it often have the other bad effects which many persons claim for it Its use in quantities of 1 to 2 liters daily should be insisted on Eggs should be given liberally, from three to six daily They should be soft boiled or poached rather than raw, although raw eggs with milk may be given when lack of appetite makes the eating of cooked eggs difficult Carbohydrate foods in the form of cooked cereals with cream, milk toast, dry toast with butter honey, milk sugar and small quantities of preserved fruits should be given in liberal amounts Baked custard, rice or tapioca pudding, well made ice cream, Jello and similar desserts are permitted To avoid vitamin deficiency, orange juice may be given and particularly thiamine in crystalline form, for which the need is great

Stuart and Pullen[13] have written of the good results obtained from the diets given patients with typhoid at the Charity Hospital in New Orleans The constituents of the diets most frequently used were strained fruit juices supplemented with 10 gm of lactose, cereal gruel with cream and sugar, eggnog made with boiled milk, strained soups, malted milk, Jello with whipped cream, custard, chocolate milk made with boiled milk, and occasionally weak tea or coffee with cream and sugar After convalescence is established a low residue diet high in protein and calories is used

**Other Considerations** Most patients with typhoid have no *appetite* This is due partly to the disagreeable condition of the mouth The *mouth* should be kept scrupulously clean, it should be washed with some agreeable, mild antiseptic solution before and after each feeding and the teeth should be carefully brushed two or three times each day If this is done and if the patient is given large quantities of *water*, less trouble from this source will be encountered The chewing of gum helps to keep the mouth clean and is to be recommended The high caloric diet itself seems to lessen trouble with the mouth

It is not out of place here to warn against the older practice of purging these patients Much of the diarrhea of typhoid of former days was

due to *purgation* The so called initial purge is almost as bad in typhoid as in appendicitis

*Intestinal hemorrhage* demands that the ingestion of all food be stopped The patient should be kept absolutely at rest, with an ice bag or other cold appliance to his abdomen, and should be given only a little cracked ice by mouth If the hemorrhage has been copious, nothing further should be given for twenty four hours After this, food in the form of small quantities of cold milk may be given cautiously Gradually the amount may be increased Morphine is sometimes necessary to insure complete rest

*Perforation* also demands the discontinuance of all food Surgical intervention is imperative

During *convalescence* there should be continued attention to the diet Although lack of appetite is a rule during the height of the disease, increased appetite is common at this stage As the fever subsides the patient feels the need of replenishing his lost stores of glycogen and of making up for his loss of protein but if he has been properly fed during the illness he will not be nearly so voracious as the convalescent of former days It is best to proceed slowly during convalescence and not permit an intake of food beyond the patient's assimilative powers

The following dietaries are typical of those which I have found suitable in typhoid The caloric and protein intake is adjusted to the needs of a patient weighing 70 kilograms It carries about 50 Calories per kilogram, and while it is not sufficient to prevent completely all protein loss, it will prevent the ill effects of the low caloric diet It may be increased or diminished as circumstances warrant

**Table 110 High Caloric Menus for Patients with Typhoid**

| | Calories (Approximate) |
|---|---|
| I (Use 20% cream for milk and 40% for cereals) | |
| 7 A M | |
| 1 glass of malted milk hot or cold | 184 |
| 1 average sized slice of milk toast | 213 |
| | 397 |
| 9 A M | |
| 1 heaping tablespoonful of farina with 2 teaspoonfuls of sugar and | 132 |
| 2 tablespoonfuls of cream* | 120 |
| ⅔ glass of milk with 2 tablespoonfuls of cream | 147 |
| | 399 |
| 11 A M | |
| 1 soft boiled egg | 60 |
| 1 slice of toast and 1 teaspoonful of butter | 149 |
| 1 heaping tablespoonful of tapioca pudding | 114 |
| ⅓ glass of milk and 2 tablespoonfuls of cream | 73 |
| | 396 |

| | Calories (Approximate) |
|---|---|
| 1 P M | |
| 3 heaping tablespoonfuls of boiled oatmeal *strained with 1 teaspoon*ful of butter and | 173 |
| 2 tablespoonfuls of cream | 120 |
| 1 glass of orange juice with 2 teaspoonfuls of sugar | 182 |
| | 475 |
| 3 P M | |
| 1 coddled egg on toast with ½ teaspoonful of butter | 169 |
| ½ tablespoonful of preserves or jelly | 53 |
| ⅔ glass of milk with 2 tablespoonfuls of cream | 147 |
| 3 tablespoonfuls of Junket | 8[illegible] |
| | 454 |
| 5 P M | |
| Milk toast | 213 |
| 2 heaping tablespoonfuls of ice cream | 189 |
| | 402 |
| 9 P M | |
| 2 heaping tablespoonfuls of Cream of Wheat with | 100 |
| *½ teaspoonful of butter 2 teaspoonfuls of sugar and* | 121 |
| 2 tablespoonfuls of cream | 120 |
| ½ glass of milk with 2 tablespoonfuls of cream | 139 |
| | 480 |
| 7 P M | |
| 8 tablespoonfuls of oatmeal gruel with | 50 |
| 4 tablespoonfuls of cream and 2 teaspoonfuls of sugar | 322 |
| *⅔ glass of milk and 2 tablespoonfuls of cream* | 147 |
| | 519 |
| Total Calories | 35[illegible]2 |

II

| | |
|---|---|
| 7 A M | |
| ⅔ glass of milk with 2 tablespoonfuls of 20% cream | 147 |
| 8 tablespoonfuls of oatmeal gruel with | 50 |
| 2 tablespoonfuls of 40% cream | 1[illegible]0 |
| 2 teaspoonfuls of sugar | 82 |
| | 399 |
| 9 A M | |
| 1 [illegible] ½ tablespoonful of jelly | 186 |
| 1 [illegible] | [illegible]9 |
| ⅔ [illegible] ream | 147 |
| | 412 |
| 11 A M | |
| *2 heaping tablespoonfuls of well cooked* farina with 2 teaspoonfuls of sugar and 2 tablespoonfuls of cream | 30[illegible] |
| ⅔ glass of milk with 2 tablespoonfuls of cream | 147 |
| | 449 |

| | Calories (Approximate) |
|---|---|
| **1 P M** | |
| 1 poached egg on 1 slice of toast 1 teaspoonful of butter | 209 |
| 1 tablespoonful of rice custard | 89 |
| 1 glass of orange juice with 2 teaspoonfuls of sugar | 182 |
| | 480 |
| **3 P M** | |
| 1 slice of toast softened with 1/2 glass of hot milk 1/2 teaspoonful of butter | 173 |
| 1 heaping tablespoonful of ice cream | 94 |
| 2/3 glass of milk with 2 tablespoonfuls of cream | 149 |
| | 416 |
| **5 P M** | |
| 1 soft boiled egg | 60 |
| 1 slice of toast with 1 teaspoonful of butter | 149 |
| 1/2 tablespoonful of preserves (no skin or seeds) | 52 |
| 3 tablespoonfuls of Junket | 85 |
| 1/2 glass of malted milk | 132 |
| | 478 |
| **7 P M** | |
| 3 tablespoonfuls of strained oatmeal with | 94 |
| 2 tablespoonfuls of cream and | 120 |
| 2 teaspoonfuls of sugar | 82 |
| 2/3 glass of milk and 2 tablespoonfuls of cream | 147 |
| | 443 |
| **9 P M** | |
| 1 glass of milk (half cream) | 240 |
| 1 heaping tablespoonful of soft custard | 113 |
| 1/2 slice of toast and 1/2 teaspoonful of butter | 74 |
| | 427 |
| Total Calories | 3504 |

| | Calories |
|---|---|
| **For 1000 Calories a Day** | |
| Milk 1 qt (1000 cc) | 700 |
| Cream 1 2/3 oz (50 cc) | 100 |
| Lactose 1 2/3 oz (50 gm) | 200 |
| This furnishes 8 feedings each containing | |
| Milk 4 oz | 80 |
| Cream 2 drams | 15 |
| Lactose 6 gm | 24 |
| **For 1500 Calories a Day** | |
| Milk 1 1/2 qt (1500 cc) | 1000 |
| Cream 1 2/3 oz | 100 |
| Lactose 3 1/3 oz (100 gm) | 400 |
| This furnishes 6 feedings each containing | |
| Milk 8 oz | 160 |
| Cream 2 drams | 15 |
| Lactose 16 gm | 64 |

For 2000 Calories a Day

| | |
|---|---|
| Milk 1½ qt | 1000 |
| Cream 8 oz (240 cc.) | 500 |
| Lactose 4 oz (125 gm) | 500 |
| *This furnishes 7 feedings each containing* | |
| Milk 7 oz | 140 |
| Cream 1 oz | 60 |
| Lactose 18 gm | 72 |

For 2500 Calories a Day

| | |
|---|---|
| Milk 1½ qt | 1000 |
| Cream 8 oz | 500 |
| Lactose 8 oz (250 gm) | 1000 |
| This furnishes 7 feedings each containing | |
| Milk 7 oz | 140 |
| *Cream 1 oz* | 60 |
| Lactose 36 gm | 144 |

*For 3000 Calories a Day*

| | |
|---|---|
| Milk 1¼ qt | 1000 |
| Cream 1 pt (480 cc) | 1000 |
| Lactose 8 oz | 1000 |
| This furnishes 8 feedings each containing | |
| Milk 6 oz | 120 |
| Cream 2 oz | 120 |
| Lactose 1 oz (30 gm) | 120 |

For 3900 Calories a Day

| | |
|---|---|
| Milk 1½ qt | 1000 |
| *Cream 1 pt* | 1000 |
| Lactose 16 oz (480 gm) | 1900 |
| This furnishes 8 feedings each containing | |
| Milk 6 oz | 120 |
| Cream 2 oz | 120 |
| Lactose 2 oz | 240 |

## TUBERCULOSIS

**Metabolism** The metabolism in tuberculosis does not show the marked increase in rate seen in typhoid, McCann and Barr[3a] found that there was not as much increase as in other fevers. Patients with incipient tuberculosis probably show no increase, but temperatures above 39° C (102.2° F) are sometimes accompanied by a metabolic rate from 20 to 30 per cent above the normal. This failure of tuberculosis to show the usual metabolic increase has been attributed to the fact that in this disease high fever is often seen with relatively little toxic disturbance. On the other hand profound toxic disturbance even though accompanied by little or no fever, will produce an increased rate. Grafe[14] found an increase in metabolism of 20 to 36 per cent in the majority of patients with severe nonfebrile tuberculosis.

Protein destruction is not as great in tuberculosis as in typhoid. McCann[3a] found that the nitrogen excretion in this disease is less than in other infections that it is not difficult to establish nitrogen equilibrium with a low protein intake and that such an equilibrium can be maintained with a daily excretion of only 2.5 to 9.4 gm of nitrogen

(15 to 60 gm of protein) In the patient with tuberculosis protein exerts the same specific dynamic action that is seen in the normal person

In discussing the influence of the various foodstuffs in this disease McCann states that carbohydrate and protein increase materially the volume of respiration as well as to total metabolism he found that 100 gm of cane sugar calls for such an increase in the production of carbon dioxide that pulmonary ventilation is increased 60 per cent Fat however does not have this disadvantage for the administration of 140 gm of fat with 1302 Calories had but little specific dynamic action and increased pulmonary ventilation only 12 per cent This author suggests that these facts support the older clinicians in the giving of large quantities of fat in tuberculosis

From these facts it is justifiable to conclude then that for proper maintenance the tuberculous patient does not as a rule require as much increase in food as is demanded in other fevers and that a proportionately large quantity of fat in the diet is of advantage

Treatment Before proceeding to a discussion of diet in tuberculosis some reference should be made to other useful therapeutic measures otherwise dietary regulation will be of little avail Every physician today knows that rest fresh air and food are the three factors which count most in promoting recovery from tuberculosis The value of rest is properly appreciated but undue emphasis is often laid on fresh air and climate and the patient is sent away chiefly to obtain the benefits of these Change of climate is often justifiable especially when the physician or the family feel that they are unable to carry out treatment at home but occasionally it is a mistake and the patient had much better remain at home where he can be comfortable and happy I say this because to the three curative factors just enumerated there should be added a fourth contentment and this cannot always be obtained amid strange surroundings This psychic side of the treatment of tuberculosis is too often neglected The patient should as far as possible be placed in congenial surroundings and should be given all legitimate encouragement Contentment is of such importance that it is even better for example to permit the tuberculous wage earner to remain in a slightly unfavorable occupation in which he is contented and successful rather than take up some new more wholesome work which he understands but poorly and in which he will have difficulty in earning a living If the importance of rest good air and contentment is fully understood and if these factors are utilized to their fullest extent then much more can be expected from the dietary treatment

Diet Tuberculosis is a debilitating disease in which emaciation is a salient feature and the effort should be to prevent this by appropriate diet So deeply have the members of the medical profession and the laity become impressed by the ominous nature of this sign that the effort is commonly made to induce the patient to gain weight at any cost the more weight the better Forced feeding is often the rule and marked gain in weight even to the point of obesity is looked on as a most satisfactory sign This is an error Gain in weight follows improvement but improvement does not necessarily follow forced gain

in weight It is an obvious error always to regard obesity as an evidence of robust health It is coming to be more and more realized that other things being equal in health or disease the lean person is the more robust and that he has the greater life expectancy Scrutiny of patients who have recovered from tuberculosis and who have long remained well is proof of the truth of this they are seldom fat The situation here is not unlike that in diabetes Increased weight even to the point of moderate obesity in diabetes is often regarded by the patient and relatives as evidence of improvement and of a satisfactory state of health in truth it is dangerous for these patients go to pieces easily sometimes with dramatic suddenness Likewise in tuberculosis marked overweight may be deceptive This is not an argument for the undernutrition which has been found desirable in diabetes but is merely a protest against the superalimentation which in tuberculosis was the practice of the past The tuberculous patient should be well nourished and should maintain his body weight at a figure which is equal to or perhaps a few pounds above the calculated ideal but he should not become fat

In this connection a warning should perhaps be given against the excessive use of milk and eggs These articles are excellent and should always be used in tuberculosis but they should not be taken to the exclusion of other good foods Mental inertia sometimes prompts the physician merely to tell the patient to take large quantities of milk and eggs such a diet requires no effort in the planning but it is not fair to the patient This statement does not apply however in those instances in which the patient is poor and is so situated that he cannot secure good well prepared food of the right kind for in these cases milk and eggs sometimes provide the only available good food The diet should be varied and well balanced

The food of the tuberculous patient should have the following characteristics

1 It should be *adequate* The patient with pulmonary tuberculosis of moderate grade with little or no fever requires about the same food in slightly increased amounts as in health A man weighing 70 kilograms who is up and about but is doing no work will need 40 to 45 Calories per kilogram of body weight approximately 2800 to 3000 Calories If he is working at some light occupation this should be increased to 3200 or 3300 Calories If he is doing actual manual labor the diet should provide about 3600 Calories Protein should be permitted in liberal though not excessive amounts (from 1 5 to 1 75 gm per kilogram of body weight or for the average patient from 100 to 125 gm daily) The belief of the older clinicians in the value of a generous fat diet in tuberculosis is borne out by the observations of McCann that fat in contradistinction to carbohydrate increases the respiratory volume but little Carbohydrate however should furnish at least 50 per cent of the energy For women these estimates may be decreased about 8 or 10 per cent The younger the patient the greater the proportionate caloric need and protein requirement These figures are merely tenta

tive for experience has demonstrated great differences in the food requirement of individual patients The physician should use good judgment and should be guided somewhat by the patient s appearance vigor and sense of well being

2 The food should provide an abundance of *vitamins* and *minerals* Witness for example the low ascorbic acid levels of the blood serum reported in this disease and the suggestion of Heise and Martin[15] and of others that in order to preserve nutritive equilibrium an increased supply of this vitamin should be provided The same is probably true of vitamin A and other nutritive essentials Getz[16] states that in almost any sanatorium with large numbers of far advanced cases of tuberculosis there are patients with evidences of scurvy and also some with all the known signs of vitamin A deficiency He emphasizes the need for additional ascorbic acid and vitamin A as well as for an especially liberal protein intake Fortunately the milk and eggs of the tuberculous patient s diet are excellent sources of vitamins and needed minerals but he should in addition be given orange juice tomato juice green vegetables and other foods rich in these factors If there is any doubt as to the adequacy of his food in respect to vitamin content it should be supplemented by these substances in concentrated form

3 The food should be *simple* easily digested and well prepared Because of lack of appetite it is often difficult to induce the patient to eat what is prescribed for him therefore it should be served as far as possible in an attractive manner It should not be monotonous Good cooking is an art it is unfortunate that among the poorer persons in this country it is so little understood It is in the cooking of meat and the preparation of vegetables that the fault most often lies In such a situation it is incumbent on the physician to give instructions or have them given to some member of the family as to the rudiments of the preparation and cooking of food The difficulty here is that persons are only too often satisfied with their own thoroughly inadequate methods of cooking and do not wish to improve Real missionary work must be done

The arrangement of the tray when the patient is in bed or the manner in which the food is served at the table is of importance Happy surroundings and pleasant conversation at the table count If the patient is in bed he should not be permitted regularly to order his own food. nor should he be told what he is to receive

4 The menu should be planned to meet individual needs and tastes A regimen which provides three meals daily without between meal feedings is as a rule best because in this way the patient will find greater enjoyment in his food but it is a mistake to adopt a fixed schedule to which every patient must adhere The physician must be familiar with the patient s habits tastes and economic status and in the arrangement of the diet must take these factors into consideration

5 Good *discipline* is advisable The physician in his dietary instructions must be explicit and he should insist that his directions be followed for laxity and too much latitude are likely to lead in the end

to complete disregard of all directions Preconceived notions of the patient or his friends, if they are unsound, should be disregarded dogmatism in dealings with patients is not bad

*Digestive disturbances* usually demand a rearrangement of the diet. Personal idiosyncrasy must receive some consideration, and no attempt should be made to force on the patient foods which disagree with him To give too much food at one time may upset the digestion, an excessive intake of fat often causes diarrhea Too much protein will sometimes cause the same disturbance An excess of carbohydrate may produce flatulence and abdominal discomfort Constipation can be corrected by increasing the roughage of the diet and by giving agar Anorexia is another great obstacle Care of the mouth, variety in the choice of food, encouragement and, above all, the administration of vitamin $B_1$ in the form of yeast or as crystalline thiamine are the measures which *help to overcome it*

*Special diets* designed for use in tuberculosis have not stood the test of time This is notably true of the Gerson Hermannsdorfer[17] diet which provides an abundance of fat, a somewhat limited intake of protein and a restricted amount of carbohydrate The consensus is that this regimen is without value, unless it is true that the recommended restriction of table salt is helpful Mayer[18] believes in restriction of salt *in pulmonary tuberculosis and writes*

> We may say th [illegible]
> must be rejected [illegible]
> that dietary mea[illegible]
> culosis Further [illegible]

We question the rationale of rigid restriction of salt in tuberculosis and believe that if the restriction is extremely rigid, harm may result

**Table 111 Menus Suitable for Patients with Tuberculosis**

I Protein 125 gm, Calories 3300

Breakfast
- ½ glass of orange juice
- Average helping of cooked cereal
- 1 poached egg 3 slices of crisp bacon 2 slices of toast
- 1 tablespoonful of butter 2 tablespoonfuls of sugar
- *1 cup of coffee ½ cup of thin cream*

Dinner
- 2 medium sized slices of roast beef with gravy
- [illegible] hed pota oes
- [illegible] with ½ tablespoonful of mayonnaise
- 1 corn muffin 1 tablespoonful of butter
- 2 heaping tablespoonfuls of apple tapioca pudding with 2 tablespoonfuls of cream
- 1 glass of milk

Supper
- 1 cup of cream of celery soup with 2 crackers
- Cheese soufflé (1 egg ⅛ cup of cheese ⅓ cup of milk 1 tablespoonful of flour ⅔ tablespoonful of butter)
- 1 medium sized baked white potato
- 1 slice of bread 1 tablespoonful of butter
- Average helping of pear sauce (canned) with 5½ tablespoonfuls of cottage cheese
- 1 glass of milk

II Protein 125 gm Calories 3300

Breakfast

Average helping of cantaloupe or strawberries or 2 tablespoonfuls of stewed fruit

1 cup of coffee

1 tablespoonful of honey

Dinner

A

4

4

1 1 tablespoonful of mayonnaise

1 slice of whole wheat bread 1 tablespoonful of butter

2 heaping tablespoonfuls of vanilla ice cream

1 glass of milk

Supper

1 cup of pea soup with 2 tablespoonfuls of croutons

2 egg omelet 1 teaspoonful of butter

Average helping of hominy grits with 1 teaspoonful of butter

Plain lettuce salad with French dressing

1 medium sized baked apple with 1 tablespoonful of whipped cream

2 slices of toast with 1 tablespoonful of butter

1 glass of milk

### Table 112 Inexpensive Menus for Patients with Tuberculosis

I Protein 80 gm Calories 2800

Breakfast

1 small baked apple or 2 tablespoonfuls of apple sauce

2 teaspoonfuls of sugar

2 heaping tablespoonfuls or average helping of boiled oatmeal with 2 teaspoonfuls of sugar and 1/ cup of milk (also for coffee)

3 slices of white meat of chicken rolled in meal

2 slices of bread or 2 biscuits 1 tablespoonful of nut butter or oleomargarine

1 cup of coffee 1 teaspoonful of sugar

Dinner

Potato soup (1 large potato cooked till soft 1 cup of diluted canned milk 1 tea spoonful of bacon fat)

Average helping of beef stew with d implings

Average helping of steamed cabbage 2 corn muffins

Average helping of bread p idding with sauce

1 glass of buttermilk 1 tablespoonful of nut butter

Supper

Large dish (about 3 heaping tablespoonfuls uncooked) of hominy grits with 1 tablespoonful of nut butter

1 egg scrambled with 2 tablespoonfuls of tomatoes

2 slices of bread with 1 tablespoonful of nut butter

2 tablespoonfuls of syrup

1 glass of milk

Bedtime

1 glass of milk 1 slice of bread with 1 teaspoonful of butter

II Protein 95 gm Calories 3000

Breakfast

1 large

Hot to

1 cup

Dinner

Average helping of baked soup meat (after boiling for soup)
*Large serving of spaghetti and tomatoes*
Average helping (1 oz) of field peas cooked with white meat
2 corn muffins
Corn starch pudding (1 cup of milk, 1 heaping tablespoonful of corn starch 1 egg 1 heaping tablespoonful of sugar), makes 2 servings
1 glass of milk

Supper

Average helping of beef soup (rice macaroni potato, etc) served with 4 square crackers

1 glass milk

Bedtime

1 glass of milk and 5 or 6 crackers

III Protein 85 gm Calories 3000

Breakfast

1 small baked apple, 1 teaspoonful of sugar
Large serving of oatmeal, 2 teaspoonfuls of sugar; ¼ cup of milk
1 soft boiled egg 2 slices of toast 1 tablespoonful of oleomargarine
1 cup of coffee with 1 teaspoonful of sugar

Dinner

Large serving of baked macaroni and cheese
Average helping of canned string beans
Scalloped tomatoes (1 cup of tomatoes, 1 slice of bread 1 teaspoonful of oleomargarine)
*2 corn muffins 1 tablespoonful of oleomargarine*
Apple tapioca pudding (1 small apple, 1 tablespoonful of pearl tapioca soaked over night 1 teaspoonful of butter)
1 glass of buttermilk

Supper

1 cup of cream of corn soup with 4 crackers
1
¼
1
1 baked banana 1 teaspoonful of sugar lemon juice
1 glass of milk

Bedtime

1 glass of milk 1 slice of bread with 1 teaspoonful of butter
1 tablespoonful of syrup or jelly

IV Protein 80 gm, Calories 3000

Breakfast

1 small orange
Large helping of hominy grits with ½ tablespoonful of oleomargarine
½ cup of milk sugar if desired
2 plain muffins with 1 tablespoonful of oleomargarine
3 slices of bacon 2 tablespoonfuls of syrup or jam
1 cup of coffee 2 tablespoonfuls of sugar

Dinner

Average helping of beef stew with vegetables
1 medium sized baked sweet potato with ½ tablespoonful of oleomargarine
Average helping of coleslaw

*2 corn muffins with 1 tablespoonful of oleomargarine*
Average helping of Indian meal pudding
1 glass of milk

Supper
1 scrambled egg
Average helping of whole hominy
*Average helping of creamed lima (dried) beans*
2 slices of bread 1 tablespoonful of oleomargarine
1 cup of hot cocoa (1 teaspoonful of sugar 1 teaspoonful of cocoa 1 cup of milk)

Bedtime
*1 glass of milk 1 slice of bread with butter and jam or cake*

**Table 113 Menus for Patients with Tuberculosis Who Must Remain in Bed**

First Day
6 A M 1 glass of orange juice
8 A M 1 egg on toast 1 glass of milk
10 A M ⅔ cup of oatmeal with 2 *teaspoonfuls* of sugar and ¼ cup of thin cream 2 tablespoonfuls of apple sauce
12 M Cup custard (1 cup of milk 1 egg 2 teaspoonfuls of sugar)
1 cup of cream of celery soup 2 crackers
2 P M *6 creamed oysters on toast*
4 P M Milk and egg shake ½ cup of apple tapioca
6 P M 1 soft egg 1 slice of toast 4 stewed figs
8 P M Cream of Wheat with ½ tablespoonful of butter and glass of milk

Total average 92 gm of protein 2600 Calories

Second Day
6 A M 1 glass of hot milk
8 A M 1 soft boiled egg 1 thin slice of toast 1 tablespoonful of butter 1 cup of *cocoa 2 tablespoonfuls of apple sauce*
10 A M Boiled custard
12 M 1 lamb chop 1 slice of toast small baked potato ½ tablespoonful of butter
2 P M 1 glass of milk
4 P M 1
6 P M 4 … onful of butter
A … ıls of whipped cream
8 P M 1 glass of milk (half thin cream)
½ cup of corn starch pudding

Total average 82 gm of protein 2611 Calories

Third day
6 A M 1 glass of orange juice
8 A M 1 cup of cooked oatmeal with 1 tablespoonful of sugar and ½ cup of thin cream
10 A M *1 coddled egg 1 slice of toast 1 tablespoonful of butter 1 tablespoonful* of marmalade
12 M Milk and egg shake with 1 teaspoonful of sugar
2 P M ¼ inch scraped beef patty small baked potato with ½ tablespoonful of butter
4 P M Average helping of rice custard 1 glass of milk
6 P M Cream of oyster soup (6 oysters 1 cup of milk 1 tablespoonful of flavoring *1 tablespoonful of butter) 4 crackers*
8 P M 1 slice of toast, 1 medium sized baked apple with 2 heaping tablespoonfuls of whipped cream
½ glass of milk

Total average 92 gm of protein, 2720 Calories

Fourth Day

6 A M 1 glass of hot milk
8 A M 1 slice of creamed toast with 2 slices of crisp bacon
1 cup of cocoa 1 soft boiled egg
10 A M 2 heaping tablespoonfuls of farina with 1 tablespoonful of sugar and 4 tablespoonfuls of cream
2 heaping tablespoonfuls of apple sauce 1 glass of milk
12 M 2 heaping tablespoonfuls of creamed chicken on toast
3 heaping tablespoonfuls of tapioca pudding 1 tablespoonful of whipped cream
2 P M 1 glass of orange juice
4 P M Milk and egg shake with 1 heaping teaspoonful of sugar
6 P M Egg on toast
1 cup cocoa
8 P M 3 heaping tablespoonfuls of Floating Island 1 glass of milk

Total average 87 gm of protein 2800 Calories

Fifth Day

6 A M 1 glass of orange juice
8 A M Average helping of farina 1 tablespoonful of sugar 4 tablespoonfuls of cream
6 panned oysters on toast 1 tablespoonful of butter
10 A M 1 glass of milk 4 large prunes
12 M ½ cup of cream of pea soup with croutons (1 slice of bread)
2 P M 1 small serving of tenderloin steak 1 tablespoonful of mashed or creamed potatoes
4 P M 2 heaping tablespoonfuls of chocolate custard 1 tablespoonful of whipped cream
6 P M 1 soft boiled egg ½ slice of toast 1 glass of milk
8 P M 1 glass of orange juice 2 crackers

Total average 87 gm of protein 2000 Calories

Sixth Day

6 A M 1 cup of hot milk 2 crackers
8 A M 2 heaping tablespoonfuls of oatmeal 2 teaspoonfuls of sugar 4 tablespoonfuls of cream 1 cup of cocoa
10 A M 1 coddled egg 3 strips of crisp bacon
1 slice of toast 1 teaspoonful of butter
12 M 6 creamed oysters on toast 1 glass of orange juice
2 P M 1 glass of milk 1 slice of toast ½ tablespoonful of butter 1 tablespoonful of applesauce
4 P M Milk and egg shake
6 P M Average helping of Cream of Wheat with ¼ tablespoonful of butter
1 glass of milk (half cream)
8 P M 1 medium sized baked apple ½ glass of milk

Total average 88 gm of protein 2672 Calories

Seventh Day

6 A M 1 glass of orange juice
8 A M 1 soft boiled egg ½ slice of toast 1 cup of cocoa ½ tablespoonful of butter
10 A M Average helping of cooked cereal 1 tablespoonful of sugar 4 tablespoonfuls of cream
12 M 1
1
2 P M 1
4 P M Milk and egg shake
6 P M 1 cup of cream of corn soup 4 crackers
Baked custard (1 egg)
8 P M 1 glass of milk 1 slice of toast 1 teaspoonful of butter

Total average 92 gm of protein 2739 Calories

**Table 114 Menus for Tuberculous Patients on Liquid and Semiliquid Diets**

Feedings Every Two Hours

| | |
|---|---|
| **First Day** | |
| 6 A M | ½ glass of orange juice |
| 8 A M | 3 heaping tablespoonfuls of strained oatmeal with 2 teaspoonfuls of sugar 2 tablespoonfuls of cream 1 cup of cocoa |
| 10 A M | 1 glass of milk ⅔ cup of boiled custard |
| 12 M | Milk toast (1 slice of toast 1 cup of hot milk 1 teaspoonful of butter) Prune soufflé |
| 2 P M | Milk and egg shake with 2 teaspoonfuls of sugar flavoring |
| 4 P M | Cream of oyster soup (3 oysters 1 teaspoonful of butter 1 cup of milk) 2 crackers |
| 6 P M | 1 soft boiled egg 1 small slice of toast 1 teaspoonful of butter 1 glass of milk |
| 8 P M | 1 glass of milk 1 medium sized baked apple with 1 tablespoonful of whipped cream |
| Average Calories | 2375 |
| **Second Day** | |
| 6 A M | 2 tablespoonfuls of prune pulp with 2 tablespoonfuls of cream |
| 8 A M | 1 soft boiled egg 1 medium sized slice of toast 1 glass of milk |
| 10 A M | ¾ cup of well cooked farina with 1 tablespoonful of sugar and ½ cup of thin cream |
| 12 M | 1 slice of creamed toast with 1 egg yolk 1 cup of cocoa |
| 2 P M | Milk and egg shake |
| 4 P M | 1 cup of cream of tomato soup with 1 slice of toast 1 teaspoonful of butter |
| 6 P M | 1 egg omelet toast 1 teaspoonful of butter 1 cup of cocoa 4 tablespoonfuls of Junket |
| 8 P M | 1 glass of milk 1 tablespoonful of whipped cream 2 tablespoonfuls of rice custard |
| Average Calories | 2500 |
| **Third Day** | |
| 6 A M | 1 glass of orange juice |
| 8 A M | 1 cup of boiled oatmeal 1 tablespoonful of prune pulp 1 tablespoonful sugar 4 tablespoonfuls of cream |
| 10 A M | 1 poached egg on toast 1 glass of milk |
| 12 M | 1 cup of cream of tomato soup with croutons (1 slice of toast) |
| 2 P M | Milk and egg shake |
| 4 P M | 1 cup of soft custard |
| 6 P M | 1 slice of toast 1 teaspoonful of butter 4 heaping tablespoonfuls of farina with ½ tablespoonful of butter and 1 glass of milk |
| 8 P M | 2 tablespoonfuls of apple sauce 1 slice of toast 1 teaspoonful of butter 1 glass of milk |
| Average Calories | 2278 |

## PNEUMONIA

**Metabolism** The metabolism in pneumonia is increased from 20 to 50 per cent above the normal basal level and in severe pneumonia may go even higher As in other infectious diseases the respiratory quotient during the febrile period is low but rises when convalescence is established

Pneumonia is distinguished by certain peculiarities of nitrogen and chloride metabolism There is a moderate increase of nonprotein nitrogen in the blood which at times is so pronounced as to suggest a

mild degree of renal insufficiency Immediately after the crisis tl a sudden increase in the output of nitrogen this probably repres breaking down of the large amount of protein exudate held in th and the excretion of the resulting disintegration products The ch content of the blood in pneumonia is low frequently below the thr value The cause of this is not clear A large quantity of chlo retained in the pulmonary exudate but this is not believed sufficient to account in full for the marked chloride retention lessened chloride content of the urine can be explained on the as tion that the body holds tenaciously to its minimal supply anc when the chloride content of the blood falls so low as to approac threshold value, little if any chloride is permitted to pass off i urine To correct this it has been suggested that patients with monia be given liberal amounts of sodium chloride by mouth or venously the possibility of edema must be kept in mind

**Treatment** Pneumonia is a general disease the salient manifest of which are in the lungs The extent and location of the pulm involvement however require comparatively little attention The presents the chief hazard and the condition of the circulation rec constant thought It is a relatively short often stormy illness in v the patient s strength and ability to endure brief but severe intoxic will determine the outcome I speak of this in order to emphasiz fact that the chief object in arranging the diet of the patient pneumonia should not be to give him an abundance of nourish but rather to require of him the least possible exertion in the t of food

Penicillin and the sulfonamide drugs have shorn pneumonia of i of its hazards The administration of the latter to rats has been sl to reduce prothrombin time [19]

**Diet** Because pneumonia is a brief illness the outcome of whi usually determined within a few days the actual amount of nou ment which the patient receives is of comparatively little import He needs liquids and for this reason should be given sufficient q tities of water and liquid foods Solid food is unnecessary Small qu ties of food at frequent intervals given with the least possible dist ance of the patient should be the rule While a certain amoun firmness is advisable the patient s preferences should be given co eration and he should not be forced to take foods which he f distasteful

Approximately 1800 Calories daily are ample for the adult who pneumonia in some cases it is better not to give even this amo The diet should include from 50 to 60 gm of protein Milk is nently suitable about 1 quart daily should be given It is best se straight but it may be peptonized or diluted with lime water the sake of variety some of the milk may be flavored with coffe cocoa or buttermilk or clabber may be given Ice cream malted r and cup custards are also suitable Two or perhaps three eggs may given daily Broths thin vegetable purees liquid cooked cereals s

as strained oatmeal or farina and fruit juices are all valuable The food should be given at regular intervals usually every two or three hours For the patient who is accustomed to drink coffee one or two cups daily is advisable and if he is unable to take food by mouth it is advisable at times to give black coffee by rectum Brief as is the usual course of the illness the suggestion has been made that some thought be given the adequacy of the patient s stores of vitamins Witness Schmidt Weyland s[70] report of the greater number of deaths from pneumonia of experimental animals which were scorbutic If an attempt is made to supply vitamins they should be given in crystalline or other concentrated form As convalescence begins semisolid and solid food may be permitted It is best to proceed with reasonable deliberation in increasing the convalescent s intake of food he should not be permitted suddenly to take a large unlimited amount

The distressing abdominal distention which sometimes accompanies pneumonia has little or nothing to do with the diet It probably represents toxic paralysis of the bowel and cannot be combated by mere dietary regulation Sunderman[71] however by administering 15 to 30 gm of sodium chloride was able to increase the chloride concentration of the blood and apparently to effect an improvement in this respect He saw no edema or other untoward results All four of his patients appeared to have less abdominal distention after the salt was given and the abdomen became soft The patients receiving salt took a slightly higher caloric diet than did the others which was attributed to diminished tympanites

Alcohol has always been regarded as a valuable food as well as a stimulant in pneumonia some patients are able to take relatively large quantities without evidence of intoxication The sickroom should not be regarded as a reformatory and the patient with pneumonia who is accustomed to the use of alcohol should continue to take it (about ½ ounce of whiskey every four hours) Alcohol is valuable in the treatment of pneumonia of elderly persons and its administration is imperative in the person who has been accustomed to its use it need not be given to the youthful patient who is unaccustomed to it

## OTHER INFECTIOUS DISEASES

The diets advised in the three diseases just discussed can with appropriate adjustment be used in all other infections The diet recommended in typhoid is suitable for any acute but debilitating long continued infection that in tuberculosis for the chronic long continued disease and that in pneumonia for the acute stormy disease of short duration With this understanding the diets for other infectious diseases require little more than passing mention

Scarlet Fever Scarlet fever is accompanied according to Du Bois[7] by marked elimination of nitrogen and sometimes by considerable retention of sodium chloride As the disease is usually of brief duration the adequacy of the diet is not of great concern It is advisable at first to give only milk and fruit juices then after a time cereals may

be added The milk may be modified in any suitable manner pepton diluted with lime water or with barley water, or flavored with c Buttermilk or koumiss may also be given Ice cream and water may be permitted in small quantities The great frequency with w *nephritis* occurs in this disease demands caution in the use of pro During the acute illness it is best to give little protein except that tained in milk Broths and meat soups should be avoided until patient has entirely recovered As convalescence begins or earlier, w the illness is not particularly severe, cereals with cream, toast orange marmalade or other preserves, and cooked fruits may be gi Later, fresh fruits and the simpler puddings, such as rice pudd tapioca pudding or cup custard, may be allowed After about t weeks, soft boiled eggs and oysters are suitable and then a little r with the simpler vegetables If nephritis develops, the diet should that recommended for glomerular nephritis Alcohols should no given

*Measles* For patients with measles the diet advised for those scarlet fever is entirely suitable It is permissible to add, however, boiled or poached eggs and other protein foods which are not allo in scarlet fever

**Mumps** Mumps demands no dietary precautions other than t which the comfort of the patient and the height of the fever sug Because of the local disturbance, the food should be largely liq Highly seasoned foods and acids increase the patient s discomfort therefore should be avoided

**Whooping Cough** Because whooping cough is often long drawn close attention to the diet is demanded Children with this disease likely to become greatly debilitated and even emaciated because t have been improperly nourished Loss of food from vomiting du the paroxysm may become a serious matter, and even independently the paroxysm it may become of frequent occurrence The food sho be simple and easily digested and should be taken at regular interv

Milk should be the chief item of the diet and for very young child the only food Strained cereals, custards gruels, broths with toast barley and home made ice cream are useful Eggs, soft boiled or poacl or in the form of custards may be given When the condition of stomach permits chicken tender roast beef and other meats should allowed Because the disease is often of long duration the physic must think of the dietary deficiency which may come from a one si diet Fruits and green vegetables should be given the latter, if necessa puréed Alcohol diluted and in small quantities has been advised W diluted whisky may with benefit be given patients with serious vomiti

**Diphtheria** In diphtheria the diet and the precautions suggested pneumonia are suitable In nursing infants it has been suggested t if the mother is susceptible, her milk should be drawn with a bre pump and fed from a bottle When there is difficulty in swallowi only liquids or semisolid food should be given, in small quantities a at regular, frequent intervals Milk, ice cream, thin gruels and malt

milk are of value This disease today is of such short duration that lack of sufficient food during the height of the attack is not of serious moment It is important, however, that enough water be given, this may be by rectum, or a nasal tube may be passed for both nourishment and water given in this manner

**Influenza** During the ascending and the acute stage of influenza the diet advised in pneumonia is suitable, later, as convalescence is established, recourse should be had to the high caloric diet advised in typhoid Good nutrition during convalescence will sometimes prevent the weakness, lassitude, neuroses and other disorders which sometimes follow influenza

**Malaria** Malaria demands merely simple, well prepared food Unfortunately, the patient who is so located that he is exposed to frequent malarial infection is often unable to secure well prepared food I am sure nutritional failure as well as the malarial organism is responsible for the debilitated, undernourished state of patients frequently seen in the country and in small towns What has been said of the diet in tuberculosis applies with equal force here During the chill and febrile paroxysm of tertian or quartan malaria, no food is necessary After the paroxysm and in chronic malaria of the estivo autumnal type, an abundance of good food is demanded If the physician believes that the patient cannot secure well prepared, appetizing food, he should recommend large quantities of milk and eggs (2 quarts of milk and four or five eggs daily)

**Typhus Fever** Typhus fever, both in the mild form, called *Brill s disease*, and in the severe form, is probably more frequent in this country than is commonly supposed Para aminobenzoic acid is highly effective in the treatment of typhus and related diseases, but according to Snyder and his associates[22] it should for best results be given early in the first week of the illness For methods of administration and precautions in the use of this vitamin the reader is referred to this report Aureomycin is also of great value in the treatment of diseases due to the Rickettsia [22a]

The type of diet recommended in typhoid is ordinarily regarded as suitable Its high caloric value is useful in preventing the debility which sometimes follows, but when this debility extends to the digestive system, it is sometimes necessary to reduce the total amount of food

A somewhat different regimen, however has been recommended by Dingledine and her associates [23] who to supply supportive treatment for eight children with advanced Rocky Mountain spotted fever, used with encouraging results a diet extremely high in protein This included a daily intake of protein of 4 gm or more per kilogram of body weight, a minimum of fat, and an abundance of carbohydrate sufficient in amount to maintain body weight This was accomplished by means of a basic diet (70 gm of protein) and four supplementary feedings either as a drink or administered through a stomach tube This last consisted of skim milk enriched with powdered milk (Casec) flavored and fortified with liberal amounts of vitamins

Basic Diet (Dingledine[23])

| | |
|---|---|
| Protein | 70 gm |
| Fat | 57 gm |
| Carbohydrate | 145 gm |
| Calories | 1373 gm |
| Vitamin A | 12 302 I U |
| Vitamin D | 45 I U |
| Thiamine | 2 mg |
| Niacin | 7 mg |
| Ascorbic acid | 150 mg |
| Riboflavin | 3 mg |

The gavage formula consisted of

| | |
|---|---|
| Skim milk | 800 cc |
| Powdered milk (Casec Mead Johnson) | 100 gm |
| Corn syrup (Karo) | 75 gm |
| Percomorph oil (Mead Johnson) | 20 drops |
| Vi penta (Hoffmann LaRoche) | 50 drops |
| Ascorbic acid | 500 mg |
| Thiamine chloride | 50 mg |
| Riboflavin | 10 mg. |
| Menadione | 1 mg |

This amount contained 115 gm of protein no fat, 118 gm of carbohydrate, and 932 Calories (0 9 per cc)

Upon refrigeration, the mixture thickened, it was warmed to body temperature before administration [23]

**Undulant Fever** This disease is appearing in the United States with increasing frequency Because the original Malta fever was transmitted by the milk of goats the belief is general that to prevent its spread all milk should be pasteurized Unfortunately however this disease is spread by means other than by the ingestion of infected food It appears that in America at least a frequent means of transmission perhaps the principal means is by contact with the flesh of infected animals several of the patients with undulant fever seen in Birmingham have been *butchers or meat handlers*

There is no special diet for patients with undulant fever This disease is a general infection which probably involves all the organs of the body and runs the course of most septic infections Because it is debilitating and long continued every effort should be made properly to nourish the patient. The type of diet advised in typhoid is suitable The duration of the infection in the chronic stage is said to be shortened by the administration of aureomycin[22a] and by the use of Brucellin a culture filtrate without bacterial cells [24]

**Septic Infections** In the various septic infections the acuteness or the chronicity of the process should to some extent govern the diet In puerperal sepsis of extreme grade for instance the type of diet recommended in pneumonia is best in the more chronic infections with *moderate elevation of temperature* the diet suggested in pulmonary tuberculosis is suitable The diet recommended in typhoid is also suitable in chronic septic infections except that an excessively high caloric intake is not necessary

Many septic infections, such as endocarditis, are essentially chronic and may continue for years, therefore the diet is of great importance Every effort should be made to give a balanced diet and to assure the patient of an adequate intake of vitamins notably of vitamins A, $B_1$ and C The first of these can be supplied in milk and cream, and the last two, if necessary, in crystalline form, 10 mg daily of thiamine and 100 mg of ascorbic acid

During the acute exacerbation of a chronic process, when the intoxication is increased and the temperature elevated the food should be liquid or semisolid Milk, cereals with cream soft boiled eggs, custards toast with orange marmalade or other preserves, broths thickened with rice, ice cream, tapioca or rice pudding and similar articles are suitable At other times, when the course of the disease is more chronic and when there is less toxemia, solid food may be given, such, for instance, as is advised in chronic pulmonary tuberculosis For such patients a well balanced diet should be provided, containing from 35 to 40 Calories per kilogram of body weight, protein should comprise from 100 to 120 gm of this diet, and milk, fruits and green vegetables in amounts sufficient to insure an adequate intake of vitamins and minerals should be included Lack of appetite especially as regards meat, may cause difficulty, everything possible should be done to make the food palatable and attractive

Meningitis In all forms this condition demands the same feeding methods The severity of the illness the frequency of convulsions and the state of the patient s consciousness should determine the diet and the frequency of feeding Liquid foods, such as milk, milk and egg, and fruit juices given in small amounts at frequent intervals are usually best Occasionally it is necessary to pass a nasal or stomach tube In the more acute stages of severe meningitis, when the giving of food is especially difficult, it may be necessary for a time to desist from all attempts at feeding a few days of starvation will do no harm, provided sufficient water is given

**Tetanus** The great difficulty in the feeding of patients who have tetanus is not in the choice of food but in the giving of any food at all At first, before the jaws become locked, a little food in liquid form can be swallowed but later the taking of anything by mouth becomes extremely difficult It has been suggested that a little semisolid food be placed inside the buccal surface in the hope that some of it may be washed around the teeth The only possible way, however, of giving these patients food in appreciable amounts is to pass a nasal tube into the stomach The nose may be sprayed with a 2 per cent solution of novocaine to facilitate the passage of the tube, or a little chloroform may be given Sometimes the tube may be left in place, attached to the cheek with adhesive tape I left such a tube in place for several days in a case of chronic tetanus and in this manner kept the patient well nourished

Tetanus is as a rule of such short duration that the question of nourishment is seldom a pressing one The giving of water is of more

immediate importance The nasal tube may be utilized for this purpose, or fluids may be given by the drop method per rectum

**Yellow Fever.** Thanks to the work of Gorgas and of Carter, this fever bids fair to disappear from the earth, therefore it seems hardly worth while to devote much space to it The most distressing feature is vomiting, which makes the taking of food especially difficult During the first few days, when the fever is high, only water and liquid foods should be given, but during the stage of remission which follows semisolid food may be given unless vomiting begins early, when attempts should not be made to give food by mouth Liberal quantities of dextrose solution should be given by rectum or intravenously in order to prevent dehydration Had this been the practice in earlier times, the mortality from this disease, no doubt, would not have been so great

**Smallpox.** The diet in this disease should vary according to the height of the fever and the severity of the intoxication, but there is always one chief rule—it must be liberal in amount during the earlier stages in order to fortify the patient against the debilitating effects of the suppurative stage To accomplish this a well planned dietary should be specifically ordered in the beginning, and precautions should be taken to see that it is observed Liberal quantities of water and other fluids at certain definite intervals should also be prescribed The dietary principles and the menus advised in typhoid are applicable in this disease When the fever is high, only liquid and semiliquid foods should be given, as it subsides, both in the interval preceding the suppurative stage and in the convalescent period, more liberal diets should be used

**Asiatic Cholera.** The chief reason for the consideration of food in this disease is not the good it may accomplish, but the undoubted harm it will do if injudiciously given Any food given during the illness is likely to be harmful

In the prevention of cholera, every effort should be made to avoid contaminated food and water During epidemics and in countries where the disease is endemic, no salads or uncooked fruits or vegetables should be eaten, and all drinking water and milk should be sterilized Eating and drinking utensils should be washed and rinsed in water which has been boiled Only ice of unquestioned purity, such as is made from sterilized water, should be used Precautions should be taken to prevent contamination of food by flies or by cooks and other servants

Three stages of Asiatic cholera are recognized (1) the premonitory stage, (2) a stage of evacuation, with purging, vomiting and muscle cramps, and (3) a stage of collapse The premonitory stage calls for prompt and rigid treatment, the chief object being absolute rest, both general and alimentary During an epidemic, even small digestive disturbances in those who are apparently healthy call for immediate rest in bed without food It is proper to give morphine at this stage, but purgatives and intestinal antiseptics are not only useless but harmful Strong[25] reported 'Long experience has demonstrated that it is better not to administer by the mouth anything that is not essential for the

patient and that the best results are to be obtained by bringing about as complete a rest of the intestines as possible" During the second and third stages the copious evacuation of fluids and the resulting collapse dominate the clinical picture The osmotic flow of fluids in large quantities from the vessels into the intestinal canal, from the tissues into the vessels and from the cells into the tissues results in extreme dehydration *This dehydration and the resulting uremia and circulatory* failure are the salient features of the disease, and their correction is the chief object of treatment No food should be given by mouth except perhaps a little rice or barley water There is no objection to giving water by mouth, if it is retained, it will probably do good

When the pulse becomes thin and thready or disappears and when the blood pressure falls, drastic measures are necessary The most valuable is the intravenous administration of large quantities of physiologic solution of sodium chloride Two liters may be given slowly within twenty to thirty minutes if necessary, this procedure may be repeated every six hours It is important that the solution be given slowly It may also be given subcutaneously, although its influence is more promptly felt when it is administered intravenously Dextrose in isotonic solution may be given alternately with the salt solution

If the pulse remains fairly good and the blood pressure does not fall alarmingly, it is permissible to depend on the rectal administration of fluids, either in the form of plain tap water or as salt solution, if in the cases of milder involvement the fluid thus given is largely retained, intravenous administration may be omitted

Anuria is a frequent accompaniment of severe cholera This is easier to prevent than it is to treat the patient for this condition, and for this reason an abundance of fluids should be supplied from the outset This and the nephritis which frequently follows are no doubt due to the influence of the cholera toxin as well as to dehydration

The statement that nothing but water should be given by mouth during the height of the disease should be qualified, for kaolin taken orally in large amounts is of definite value Strong cited the experience of Kuhne during the Balkan Wars the latter was able by means of kaolin to reduce the mortality of this disease from 45 to 2 or 3 per cent Through purely mechanical influences on the mucosa of the stomach and intestines kaolin controls vomiting and lessens diarrhea, and through its adsorptive qualities it probably takes up a part of the cholera toxin One hundred grams of kaolin are suspended in 0 25 liter of water, and the patient is instructed to take a glassful cold every hour or half hour, about six glasses carrying approximately 200 gm of kaolin in the first twelve hours is said to be sufficient On subsequent days it should be taken at longer intervals If necessary it may be given through a stomach tube Perhaps the method of Walker is better a large supply of kaolin suspension in water, half and half is placed at the bedside the patient is encouraged to drink some of this at frequent intervals and in as large amounts as possible

Coffee furnishes another exception to the rule, for it is of benefit both as a stimulant to the circulation and as a diuretic Black coffee may be

given by mouth if it is well borne, otherwise it should be given by rectum

If the patient does not die during the stage of collapse, he later enters a period of reaction the chief dangers of which are hyperpyrexia and continued anuria Complete abstinence from food should be continued for a time, but as he recovers his equilibrium the simpler foods may be given In view of the frequency of nephritis in cholera the first food of convalescence should consist of strained cereals and cream with milk and fruit juices, later, other foods may gradually be added

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# 23

## *Diseases of the Heart and Arteries*

The ability of the heart to meet the demands made upon it, and therefore its competence, can be influenced materially by diet. This was seen in the improvement in cardiac efficiency which after World War I came from the correction of the extreme nutritional failure experienced in the Central Empires.[1] It is seen also in the improvement which follows appropriate additions to the diet of patients with beriberi and other specific states of nutritive failure. Such states were described in chapter 14, and the present discussion therefore will be concerned solely with the benefits which under other circumstances accrue from well-considered dietary regulation.

By proper dietary regulation not only can the heart be spared the immediate burden of an overfilled stomach, with the resulting increased blood flow, but other effects, vastly farther reaching, are accomplished: through a reduction in body weight the amount of work demanded of the heart is lessened.

The benefit that comes to the heart from mere reduction in body weight is easily apparent in the obese person. The difficulties of such a person are fourfold: (1) Even though the integrity of the heart is unimpaired, there is lack of balance between the body mass and the strength of the heart. (2) This organ itself may be the seat of abnormal fat deposits, both on the surface and between the individual muscle bundles, with consequent loss of muscular efficiency. (3) Accumulations of fat in the abdomen, by limiting the movements of the diaphragm, interfere with free heart action. (4) The atherosclerosis which often accompanies obesity may involve the coronary arteries. Because of the lessened cardiac efficiency, relative or absolute, thus experienced, the obese person should reduce his body weight. If there is cardiac impairment of other nature also, then the need for reduction is even more imperative.

It is not the obese person alone whose cardiac disability is lightened by reduction of body weight. Those of normal weight also benefit, apparently to an equal or even greater degree. This was predicated as a possible result of starvation in Lusk's[2] monograph on the physiologic effects of undernutrition; more recently the advantages which come to the heart from a lowering of the metabolic rate have been pointed out by Du Bois[3] and others. Witness the benefits which have been claimed

for total thyroidectomy Evidence is accumulating that such benefits can be most satisfactorily accomplished by means of a subcaloric diet

The first consideration then in the dietary treatment of the failing heart is the reduction of the total caloric intake This brings the basal metabolism to a lower level and directly improves the cardiac efficiency the latter being accomplished in part by a slowing of the heart rate This reduction in rate to a figure materially below the normal has been shown by Harrison and his associates[4] greatly to lessen cardiac fatigue and as was demonstrated by Wearn [5] to facilitate the work of the hyper trophied muscle Such improvement has been successfully accomplished by Proger and Magendantz[6] for patients with cardiac failure and by Master Jaffe and Dack[7] for those with disease of the coronary arteries Indeed in the presence of a normal rhythm the slowing of the heart rate accomplished by dietary restriction is said by the former authors to be more regularly observed and of greater magnitude than that obtained from digitalis Other significant effects of the subcaloric diet seen in the cited studies were a drop in both systolic and diastolic blood pressure a slight increase in the velocity of blood flow and a definite decrease in the size of the heart Most significant perhaps was an increase in vital capacity together with a decrease in pulmonary ventilation The last mentioned changes are the reverse of those which take place in the fail ing heart and can therefore be regarded as a clear cut indication of im provement Confirmation of this is seen in the subsequent experiments upon obese patients of Master and his associates [8] who were able by means of a 1200 Calory diet and consequent reduction in weight to reduce the work of the heart by an average of 35 per cent Thus it has definitely been shown that undernutrition lessens the burden of the heart and thereby improved its efficiency

No ill effects have been observed from the low caloric diet Master and his associates reported that there were no significant changes in the blood sugar or in the serum protein values and no ketosis or dehydra tion Even though the cardiac output was lessened there was no lowering of cardiac efficiency or loss of muscular strength the toler ance for exercise was sometimes improved These physicians saw no demonstrable change for the worse in their patients even after periods of three to twelve months on diets valued at 800 to 1200 Calories all of which confirms the original observation of Lusk that the animal organ ism has the ability successfully to adapt itself to a restricted caloric intake

As a result of the changes noted clinical improvement in cardiac fail ure is as a rule soon apparent The physician may perhaps hesitate to advise dietary restriction of a patient with a normal or subnormal weight but there is good evidence for the belief that when the normal weight becomes subnormal the benefits to the impaired cardiovascular system are even greater than when a condition of overweight is merely corrected Since slowing of the pulse and decrease in blood pressure such as have been shown to accompany undernutrition materially re duce cardiac work the patient with cardiac failure or threatened failure should adjust himself to a subcaloric regimen

The diet should be well balanced and of low caloric value Because of the beneficial effect which dextrose has been shown to have on the injured myocardium[9] carbohydrate should furnish the bulk of the energy, and because loss of protein is inevitable in achieving the desired state of undernutrition no effort should be made to preserve a positive nitrogen balance For the latter reason and also because the animal experiments of Moore[10] showed that protein foods invariably bring about cardiac acceleration of surprising magnitude and duration the intake of protein should be restricted

The regimen devised by Proger and Magendantz[6] permits in the beginning less than 400 Calories which allowance is later materially increased Master,[11] in treating patients with coronary thrombosis advised a daily intake of 800 Calories for the first three months and then gradually a more liberal regimen This will be discussed presently

*The vitamin and mineral content of such a restricted diet should* always receive consideration If one glass of skimmed milk *(preferably* two glasses) some cottage cheese and a few vegetables and fruits are included in the diet the patient is not likely to suffer acutely in this respect When the food allowance of the low caloric diet is increased the amount of these articles should be increased first Even then the addition of thiamine 10 mg daily and ascorbic acid 100 mg daily is a wise procedure

Interest has been revived in sodium (salt) restriction in the treatment of congestive heart failure Wheeler Bridges and White[12] report excellent results from this measure but add that in general patients with coronary and hypertensive heart disease respond much better than do those with rheumatic heart disease The diet used by them in the *hospital contains about 625 mg of sodium (1 5 gm of salt) and* 1800 Calories The patients are allowed as much fluids as they desire This diet yields a neutral ash which was regarded as of no importance since most of the patients were given ammonium chloride For ambulatory office patients the diet used by these authors was not quite so strict emphasis being placed principally on the elimination of all salt from cooking and the use of salt free bread and butter

The following precautions are necessary (1) Salt soda or baking powder should not be used in the cooking or at the table Substitutes for salt which contain sodium should not be used *(2) Sweet butter* or butter that has been washed free of salt may be used Bread and salad dressings must be prepared salt free Canned foods unless prepared salt free should not be used (3) Salty appetizers or salted foods such as nuts potato chips sardines olives pickles and relishes are to be guarded against Cheese and smoked or salted meats are not permitted (4) Medicines containing sodium should not be used against gas or indigestion Calcium salts are helpful in this regard (5) If the tap water contains significant quantities of sodium (Appendix Table 141) distilled water should be substituted for drinking and cooking *Water which has* been softened by the exchange of sodium ion for calcium is to be avoided.

This low salt regimen has the disadvantages of the occasional difficulty in obtaining this diet the flat taste of the food and the danger

(not encountered by these clinicians) of too severely depleting the sodium content of the tissues These disadvantages, however, are not formidable and they are apparently greatly outweighed by the advantages which the authors just quoted enumerate as follows (*a*) it enables one frequently to control the edema which cannot be controlled by other measures, (*b*) it eliminates or diminishes the necessity for the use of mercurial diuretics, and (*c*) it permits the patient to take more fluids

**Table 115 Low Sodium Neutral Ash Diet without Added Salt (Typical Case)**
(Wheeler and others[12])

| Acid Normal Hydrochloric Acid (Cc) | Base Normal Sodium Hydroxide, (Cc) | Food (Gm) | Protein (Gm) | Fat (Gm) | Carbohydrate (Gm) | Sodium (Gm) |
|---|---|---|---|---|---|---|
| | 6 4 Orange juice | 120 | | | 12 0 | 0 014 |
| | 4 9 Grapefruit juice | 120 | 0 4 | | 13 2 | 0 005 |
| 6 5 | White bread (made without salt) | 100 | 9 2 | 1 3 | 53 1 | 0 032 |
| | 9 9 Whole milk | 620 | 20 5 | 24 8 | 31 0 | 0 316 |
| | Salt free butter | 45 | 0 5 | 38 3 | | 0 003 |
| 2 0 | Farina | 20 | 2 2 | 0 3 | 15 3 | 0 013 |
| 13 2 | Beef | 80 | 16 2 | 6 3 | | 0 072 |
| 5 3 | Chicken | 45 | 9 7 | 1 1 | | 0 042 |
| 8 5 | Egg | 50 | 6 7 | 5 3 | | 0 070 |
| | 5 6 Fresh tomatoes | 100 | 1 2 | 0 2 | 4 0 | 0 012 |
| 0 9 | Fresh peas | 100 | 3 6 | 0 2 | 9 8 | 0 013 |
| | 4 1 Applesauce | 120 | 0 2 | 0 1 | 23 6 | 0 013 |
| | Sugar | 35 | | | 35 0 | |
| | 0 4 Cream | 60 | 1 4 | 9 6 | 2 4 | 0 018 |
| 36 4 | 31 3 | | 71 8 | 87 4 | 199 4 | 0 0623 |

Calcium 1870 gm sodium content 0 623 gm, chloride 0 9 gm sodium chloride 1 5 gm total fluids (including water) 2 5 to 3 liters per diem

Anorexia and nausea sometimes present a serious problem in the feeding of the patient with heart disease It may be possible in such cases to rearrange the food so that it will have greater appeal It is well to remember that a patient will sometimes retain solid foods when he cannot retain liquids and also that it may be necessary for a time to violate the rule prohibiting highly seasoned foods

**Acute Cardiac Infections** Patients with acute infection of the heart, such as occurs in endocarditis and the carditis of rheumatic fever, require the type of diet advised in Chapter 22 for patients with septic infections or, if the illness is severe, pneumonia The chief object should be to provide adequate nourishment while asking the least possible exertion of the patient Liquid and semiliquid foods such as milk, thickened broths, cereals with cream and soft boiled eggs, should be given in small amounts at frequent intervals (about every three hours) Orange juice and other fruit juices form desirable additions In subacute and chronic cardiac infections a more liberal diet containing a little tender meat and well cooked vegetables, may be permitted

**Table 116 Menus for Patients with Myocardial Failure**

I (Approximate values 50 gm of protein and 1000 Calories)
Breakfast
- ½ glass orange juice
- 1 thin slice toast 1 teaspoonful jelly
- 2 very thin slices crisp bacon
- 1 cup weak coffee or tea ¼ cup whole milk

Dinner
- Medium sized helping cheese soufflé (1 egg white 2 yolks)
- 1 slice toast
- 2 tablespoonfuls lemon gelatin (1 teaspoonful gelatin 1 tablespoonful cold water ¼ cup boiling water 1 tablespoonful sugar) ¼ cup whole milk
- 1 glass skimmed milk

Supper
- Rice cooked with milk (2 tablespoonfuls rice ½ cup milk cooked in double boiler)
- Peach whip (2 halves canned peaches 1 egg white)
- *1 glass skimmed milk*

II (Approximate values 50 gm of protein and 860 Calories)
Breakfast
- 1 orange arranged in sections
- 2 heaping tablespoonfuls farina ¼ cup milk
- 1 cup weak cocoa (half milk and water) 1 teaspoonful sugar

Dinner
- Small helping breast of chicken
- 1 small baked potato
- Average helping snow pudding
- 1 glass skimmed milk

Supper
- Milk toast (1 slice toast ½ cup milk ½ teaspoonful butter)
- Baked apple free from skin and core
- 2 tablespoonfuls custard sauce
- 1 glass skimmed milk

III (Approximate values 50 gm of protein and 1000 Calories)
Breakfast
- ½ cup fresh berries in season or ½ glass orange juice
- Corn flakes with ½ glass milk
- Weak coffee or tea with milk or lemon 1 teaspoonful sugar

Dinner
- 1 heaping tablespoonful buttered noodles
- Small serving tender roast beef
- Fruit cup (½ cup orange and grapefruit)
- 1 glass skimmed milk

Supper
- 2 tablespoonfuls buttered grits
- Individual baked custard (½ cup milk 1 egg yolk 1 teaspoonful sugar)
- 1 glass skimmed milk

IV (Approximate values 50 gm of protein and 1025 Calories)
Breakfast
- ½ glass orange juice
- 1 piece zwieback
- 2 thin strips bacon 1 teaspoonful jelly
- Cocoa coffee or tea weakened with ¼ cup milk 1 teaspoonful sugar

Dinner
- Cheese omelet (1 egg 1 heaping teaspoonful American cheese)
- Snow pudding
- 1 slice toast
- 1 glass skimmed milk

Supper
- ½ cup cream of pea soup crackers
- 1 piece zwieback
- 1 half canned pear
- 1 glass skimmed milk

V (Approximate values 55 gm of protein and 975 Calories)
Breakfast
- ½ medium sized grapefruit
- Average helping Cream of Wheat with ¼ cup whole milk
- 1 cup weak tea or cocoa 1 tablespoonful cream 1 teaspoonful sugar

Dinner
- Average helping boiled fish
- 1 heaping tablespoonful rice potato
- Floating island pudding
- 1 glass skimmed milk

Supper
- 1 poached egg on toast
- 2 halves canned peaches (no juice)
- 1 glass skimmed milk

**Coronary Occlusion** The patient with coronary occlusion requires above all absolute rest, for the first thirty six or forty eight hours little thought need be given to nourishment except perhaps to see to it that ill advised attempts at feeding are not made Absolute rest for the stomach is best, and no food should be urged on the patient Water is important and during this period may be given by mouth, preferably in the form of orange juice or other fruit juices or perhaps a little milk The total intake of fluids should be limited to 1000 to 1500 cc, but no fixed rule is applicable in all cases

Later, as the patient recovers from the first effects of the coronary accident (on the third and fourth day), a low caloric diet should be instituted Falk[13] advises at this time a soft diet which may include cooked cereals weak tea broth, gelatin, cottage cheese apple sauce, junket baked potatoes and soft boiled eggs The diet successfully used by Master[11] provides 800 Calories and consists of 80 gm of carbohydrate 50 gm of protein and 30 gm of fat The intake of salt is restricted

Table 117 Well Balanced Diet of Low Caloric Content (Master[11])

Breakfast
- 1 small serving fruit without sugar
- 2 tablespoonfuls of cooked cereal
- 1 glass of milk buttermilk or skim milk
- ½ slice of bread or toast
- Coffee or tea without sugar or cream

Dinner
- 1 cup of broth if desired
- 2 ounces of lean meat or fish or chicken
- ½ cup of vegetables
- 1 small serving of fruit without sugar
- ½ slice of bread
- Coffee or tea without sugar or cream

Supper
- 1 ounce of pot cheese or 1 egg
- ½ cup of vegetables
- ½ slice of bread
- 1 glass of milk buttermilk or skim milk

It is rare that the patient suffers greatly from hunger. Among the devices used in overcoming the pangs of hunger, Master mentions the use of clear broth, jellied consommé, tomato juice and other satisfying foods of low caloric value. The patient should be told to eat slowly and to chew his food well.

In this discussion of diet it is not inappropriate to add that the patient should not be exhausted by efforts at frequent bowel movements. Laxatives or cathartics should as a rule be ordered only in order to overcome the effects of morphine or codeine. One, two or even three days without a bowel movement is not hurtful; then a glycerin or oil enema may be given. In this the physician must learn to resist the importunities of both the patient and his family.

The object of this diet is to achieve a loss of body weight with a reduction in basal metabolism and also to accomplish the other benefits which come to the heart from judicious undernutrition. It should be continued beyond the acute stage of the illness, usually for four and preferably for six weeks, and then increased gradually to 1200 and 1500 and finally to 2000 or more Calories. In adding to the diet, one should observe the rules previously outlined.

**Angina Pectoris.** Angina pectoris demands a dietary regimen which will throw the smallest burden upon the digestive organs. The instances of death from "acute indigestion" published in the daily papers usually represent coronary occlusion or angina pectoris precipitated by a heavy meal. As in coronary occlusion, though not to the same extent, the caloric intake should be restricted. This is of great importance in the prevention of crises, particularly if the patient is overweight. The food should be simple; it should be easily digested and the meals should be small. If necessary, a glass of milk or other light food may be taken between meals. There is no reason for eliminating meat from the diet; the patient may be permitted one average-sized helping daily. One cup of coffee daily may be permitted.

**Chronic Cardiac Disease.** Chronic cardiac disease, with or without myocardial failure, often benefits from a subcaloric regimen. If failure is imminent or is already present, rest in bed with rigid dietary restriction should be prescribed. If the heart is still competent, the regimen should be such as will reduce the body weight 10 or 15 per cent below the calculated normal and will depress the basal metabolism 15 per cent or more. This diet should be (*a*) low in caloric value (800 to 1200), (*b*) relatively high in carbohydrate and poor in protein, and (*c*) low in salt. This is the type of diet used successfully by Proger and Magendantz.[6] Their regimen provides at first an extremely low intake, only 356 Calories daily, consisting of 48 gm. of carbohydrate, 32 gm. of protein and 4 gm. of fat. After one or two weeks this allowance is increased to 600 Calories, provided by 80 gm. of carbohydrate, 43 gm. of protein and 13 gm. of fat. After the required amount of weight has been lost and the metabolism adequately reduced, the diet is increased to from 800 to 1000 Calories. Finally, on discharge, a total of 1200 Calories is prescribed, provided by 121 gm. of carbohydrate, 63 gm. of protein and 53 gm. of fat. These diets are outlined in Table 118.

**Table 118. Sample Diets and Menus of Different Caloric Levels***
(Proger and Magendantz[6])

| Food | Total | Carbohydrate | Protein | Fat | Calcium | Phosphorus | Iron |
|---|---|---|---|---|---|---|---|
| Diet of 356 Calories | | | | | | | |
| Skimmed milk. | 240 | 12 | 8 | 1 | 0.293 | 0.230 | 0.0006 |
| Meat, fish or chicken | 45 | | 12 | 3 | 0.006 | 0.112 | 0.0015 |
| Cottage cheese | 35 | 1 | 7 | | 0.088 | 0.285 | |
| Bread, whole grain | 30 | 16 | 3 | | 0.015 | 0.065 | 0.0007 |
| Vegetables, 5 per cent | 200 | 8 | 2 | | 0.022 | 0.052 | 0.0008 |
| Fruit, 10 per cent | 100 | 11 | | | 0.045 | 0.021 | 0.0005 |
| Totals | | 48 | 32 | 4 | 0.469 | 0.765 | 0.0041 |
| Diet of 609 Calories | | | | | | | |
| Skimmed milk | 240 | 12 | 8 | 1 | 0.293 | 0.230 | 0.0006 |
| Meat, fish or chicken | 60 | | 14 | 7 | 0.008 | 0.150 | 0.0020 |
| Egg | (1) | | 6 | 5 | 0.033 | 0.090 | 0.0015 |
| Cottage cheese | 45 | 2 | 9 | | 0.112 | 0.366 | |
| Bread, whole grain | 45 | 24 | 4 | | 0.022 | 0.0082 | 0.0011 |
| Vegetables, 5 per cent | 200 | 8 | 2 | | 0.022 | 0.052 | 0.0008 |
| Fruit, 10 per cent | 300 | 33 | | | 0.135 | 0.063 | 0.0015 |
| Totals | | 80 | 43 | 13 | 0.625 | 1.0492 | 0.0075 |
| Diet of 800 Calories | | | | | | | |
| Skimmed milk | 240 | 12 | 8 | 1 | 0.293 | 0.230 | 0.0006 |
| Meat, fish or chicken | 90 | | 22 | 10 | 0.012 | 0.225 | 0.0030 |
| Egg | (1) | | 6 | 5 | 0.033 | 0.090 | 0.0015 |
| Cottage cheese | 45 | 2 | 9 | | 0.112 | 0.366 | |
| Bread, whole grain | 90 | 48 | 9 | | 0.045 | 0.196 | 0.0021 |
| Vegetables, 5 per cent | 300 | 12 | 3 | | 0.033 | 0.078 | 0.0012 |
| Fruit, 10 per cent | 300 | 33 | | | 0.135 | 0.063 | 0.0015 |
| Totals | | 107 | 57 | 16 | 0.663 | 1.248 | 0.0099 |
| Diet of 1095 Calories | | | | | | | |
| Milk | 360 | 18 | 12 | 15 | 0.432 | 0.334 | 0.0009 |
| Meat, fish or chicken | 120 | | 27 | 14 | 0.016 | 0.300 | 0.0040 |
| Egg | (1) | | 6 | 5 | 0.033 | 0.090 | 0.0015 |
| Bread, whole grain | 90 | 48 | 9 | | 0.045 | 0.196 | 0.0021 |
| Vegetables, 5 per cent | 300 | 12 | 3 | | 0.033 | 0.078 | 0.0012 |
| Fruit, 10 per cent | 300 | 33 | | | 0.135 | 0.063 | 0.0015 |
| Butter | 15 | | | 13 | 0.002 | 0.003 | |
| Totals | | 111 | 57 | 47 | 0.696 | 1.064 | 0.0112 |
| Diet of 1200 Calories | | | | | | | |
| Milk | 480 | 24 | 16 | 20 | 0.576 | 0.445 | 0.0012 |
| Meat, fish or chicken | 120 | | 27 | 14 | 0.016 | 0.300 | |
| Egg | (1) | | 6 | 5 | 0.033 | 0.090 | 0 |
| Bread, whole grain | 90 | 48 | 9 | | 0.045 | 0.196 | 0 |
| Vegetables, 5 per cent | 400 | 16 | 4 | | 0.044 | 0.104 | 0 |
| Fruit, 10 per cent | 300 | 33 | | | 0.135 | 0.063 | |
| Butter | 15 | | | 13 | 0.002 | 0.003 | |
| Totals | | 121 | 62 | 52 | 0.851 | 1.201 | |

*Normal mineral requirement for an adult calcium, 0.68 Gm., phosph
iron 0.015 Gm., per day

It is rare that the patient suffers greatly from hunger Among the devices used in overcoming the pangs of hunger, Master mentions the use of clear broth, jellied consommé, tomato juice and other satisfying foods of low caloric value The patient should be told to eat slowly and to chew his food well

In this discussion of diet it is not inappropriate to add that the patient should not be exhausted by efforts at frequent bowel movements Laxatives or cathartics should as a rule be ordered only in order to overcome the effects of morphine or codeine One, two or even three days without a bowel movement is not hurtful, then a glycerin or oil enema may be given In this the physician must learn to resist the importunities of both the patient and his family

The object of this diet is to achieve a loss of body weight with a reduction in basal metabolism and also to accomplish the other benefits which come to the heart from judicious undernutrition It should be continued beyond the acute stage of the illness, usually for four and preferably for six weeks, and then increased gradually to 1200 and 1500 and finally to 2000 or more Calories In adding to the diet, one should observe the rules previously outlined

**Angina Pectoris** Angina pectoris demands a dietary regimen which will throw the smallest burden upon the digestive organs The instances of death from "acute indigestion" published in the daily papers usually represent coronary occlusion or angina pectoris precipitated by a heavy meal As in coronary occlusion though not to the same extent, the caloric intake should be restricted This is of great importance in the prevention of crises, particularly if the patient is overweight The food should be simple it should be easily digested and the meals should be small If necessary, a glass of milk or other light food may be taken between meals There is no reason for eliminating meat from the diet, the patient may be permitted one average sized helping daily One cup of coffee daily may be permitted

**Chronic Cardiac Disease.** Chronic cardiac disease with or without myocardial failure, often benefits from a subcaloric regimen If failure is imminent or is already present, rest in bed with rigid dietary restriction should be prescribed If the heart is still competent, the regimen should be such as will reduce the body weight 10 or 15 per cent below the calculated normal and will depress the basal metabolism 15 per cent or more This diet should be (*a*) low in caloric value (800 to 1200), (*b*) relatively high in carbohydrate and poor in protein, and (*c*) low in salt This is the type of diet used successfully by Proger and Magendantz[6] Their regimen provides at first an extremely low intake, only 356 Calories daily, consisting of 48 gm of carbohydrate 32 gm of protein and 4 gm of fat After one or two weeks this allowance is increased to 600 Calories, provided by 80 gm of carbohydrate, 43 gm of protein and 13 gm of fat After the required amount of weight has been lost and the metabolism adequately reduced the diet is increased to from 800 to 1000 Calories Finally, on discharge a total of 1200 Calories is prescribed, provided by 121 gm of carbohydrate 63 gm of protein and 53 gm of fat These diets are outlined in Table 118

**Table 118 Sample Diets and Menus of Different Caloric Levels***
(Proger and Magendantz[6])

| Food | Total | Carbohydrate | Protein | Fat | Calcium | Phosphorus | Iron |
|---|---|---|---|---|---|---|---|
| **Diet of 356 Calories** | | | | | | | |
| Skimmed milk | 240 | 12 | 8 | 1 | 0 293 | 0 230 | 0 0006 |
| Meat, fish or chicken | 45 | | 12 | 3 | 0 006 | 0 112 | 0 0015 |
| Cottage cheese | 35 | 1 | 7 | | 0 088 | 0 285 | |
| Bread, whole grain | 30 | 16 | 3 | | 0 015 | 0 065 | 0 0007 |
| Vegetables, 5 per cent | 200 | 8 | 2 | | 0 022 | 0 052 | 0 0008 |
| Fruit, 10 per cent | 100 | 11 | | | 0 045 | 0 021 | 0 0005 |
| Totals | | 48 | 32 | 4 | 0 469 | 0 765 | 0 0041 |
| **Diet of 609 Calories** | | | | | | | |
| Skimmed milk | 240 | 12 | 8 | 1 | 0 293 | 0 230 | 0 0006 |
| Meat, fish or chicken | 60 | | 14 | 7 | 0 008 | 0 150 | 0 0020 |
| Egg | (1) | | 6 | 5 | 0 033 | 0 090 | 0 0015 |
| Cottage cheese | 45 | 2 | 9 | | 0 112 | 0 366 | |
| Bread, whole grain | 45 | 24 | 4 | | 0 022 | 0 0082 | 0 0011 |
| Vegetables, 5 per cent | 200 | 8 | 2 | | 0 022 | 0 052 | 0 0008 |
| Fruit, 10 per cent | 300 | 33 | | | 0 135 | 0 063 | 0 0015 |
| Totals | | 80 | 43 | 13 | 0 625 | 1 0492 | 0 0075 |
| **Diet of 800 Calories** | | | | | | | |
| Skimmed milk | 240 | 12 | 8 | 1 | 0 293 | 0 230 | 0 0006 |
| Meat, fish or chicken | 90 | | 22 | 10 | 0 012 | 0 225 | 0 0030 |
| Egg | (1) | | 6 | 5 | 0 033 | 0 090 | 0 0015 |
| Cottage cheese | 45 | 2 | 9 | | 0 112 | 0 366 | |
| Bread, whole grain | 90 | 48 | 9 | | 0 045 | 0 196 | 0 0021 |
| Vegetables, 5 per cent | 300 | 12 | 3 | | 0 033 | 0 078 | 0 0012 |
| Fruit, 10 per cent | 300 | 33 | | | 0 135 | 0 063 | 0 0015 |
| Totals | | 107 | 57 | 16 | 0 663 | 1 248 | 0 0099 |
| **Diet of 1095 Calories** | | | | | | | |
| Milk | 360 | 18 | 12 | 15 | 0 432 | 0 334 | 0 0009 |
| Meat, fish or chicken | 120 | | 27 | 14 | 0 016 | 0 300 | 0 0040 |
| Egg | (1) | | 6 | 5 | 0 033 | 0 090 | 0 0015 |
| Bread, whole grain | 90 | 48 | 9 | | 0 045 | 0 196 | 0 0021 |
| Vegetables, 5 per cent | 300 | 12 | 3 | | 0 033 | 0 078 | 0 0012 |
| Fruit, 10 per cent | 300 | 33 | | | 0 135 | 0 063 | 0 0015 |
| Butter | 15 | | | 13 | 0 002 | 0 003 | |
| Totals | | 111 | 57 | 47 | 0 696 | 1 064 | 0 0112 |
| **Diet of 1200 Calories** | | | | | | | |
| Milk | 480 | 24 | 16 | 20 | 0 576 | 0 445 | 0 0012 |
| Meat, fish or chicken | 120 | | 27 | 14 | 0 016 | 0 300 | 0 0040 |
| Egg | (1) | | 6 | 5 | 0 033 | 0 090 | 0 0015 |
| Bread, whole grain | 90 | 48 | 9 | | 0 045 | 0 196 | 0 0021 |
| Vegetables, 5 per cent | 400 | 16 | 4 | | 0 044 | 0 104 | 0 0016 |
| Fruit, 10 per cent | 300 | 33 | | | 0 135 | 0 063 | 0 0015 |
| Butter | 15 | | | 13 | 0 002 | 0 003 | |
| Totals | | 121 | 62 | 52 | 0 851 | 1 201 | 0 0119 |

*Normal mineral requirement for an adult calcium, 0 68 Gm , phosphorus, 1.32 Gm ; iron, 0 015 Gm , per day

It is rare that the patient suffers greatly from hunger Among the devices used in overcoming the pangs of hunger, Master mentions the use of clear broth, jellied consommé, tomato juice and other satisfying foods of low caloric value The patient should be told to eat slowly and to chew his food well

In this discussion of diet it is not inappropriate to add that the patient should not be exhausted by efforts at frequent bowel movements Laxatives or cathartics should as a rule be ordered only in order to overcome the effects of morphine or codeine One, two or even three days without a bowel movement is not hurtful, then a glycerin or oil enema may be given In this the physician must learn to resist the importunities of both the patient and his family

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**Table 118 Sample Diets and Menus of Different Caloric Levels***
(Proger and Magendantz[6])

| Food | Total | Carbo-hydrate | Pro-tein | Fat | Calcium | Phos-phorus | Iron |
|---|---|---|---|---|---|---|---|
| of 356 Calories | | | | | | | |
| ımmed milk | 240 | 12 | 8 | 1 | 0 293 | 0 230 | 0 0006 |
| eat, fish or chicken | 45 | | 12 | 3 | 0 006 | 0 112 | 0 0015 |
| ›ttage cheese | 35 | 1 | 7 | | 0 088 | 0 285 | |
| ead, whole grain | 30 | 16 | 3 | | 0 015 | 0 065 | 0 0007 |
| getables, 5 per cent | 200 | 8 | 2 | | 0 022 | 0 052 | 0 0008 |
| uit, 10 per cent | 100 | 11 | | | 0 045 | 0 021 | 0 0005 |
| Totals | | 48 | 32 | 4 | 0 469 | 0 765 | 0 0041 |
| of 609 Calories | | | | | | | |
| ımmed milk | 240 | 12 | 8 | 1 | 0 293 | 0 230 | 0 0006 |
| eat, fish or chicken | 60 | | 14 | 7 | 0 008 | 0 150 | 0 0020 |
| gg | (1) | | 6 | 5 | 0 033 | 0 090 | 0 0015 |
| ›ttage cheese | 45 | 2 | 9 | | 0 112 | 0 366 | |
| ead, whole grain | 45 | 24 | 4 | | 0 022 | 0 0082 | 0 0011 |
| egetables, 5 per cent | 200 | 8 | 2 | | 0 022 | 0 052 | 0 0008 |
| uit, 10 per cent | 300 | 33 | | | 0 135 | 0 063 | 0 0015 |
| Totals | | 80 | 43 | 13 | 0 625 | 1 0492 | 0 0075 |
| of 800 Calories | | | | | | | |
| ımmed milk | 240 | 12 | 8 | 1 | 0 293 | 0 230 | 0 0006 |
| leat, fish or chicken | 90 | | 22 | 10 | 0 012 | 0 225 | 0 0030 |
| gg | (1) | | 6 | 5 | 0 033 | 0 090 | 0 0015 |
| ottage cheese | 45 | 2 | 9 | | 0 112 | 0 366 | |
| read, whole grain | 90 | 48 | 9 | | 0 045 | 0 196 | 0 0021 |
| egetables, 5 per cent | 300 | 12 | 3 | | 0 033 | 0 078 | 0 0012 |
| ruit, 10 per cent | 300 | 33 | | | 0 135 | 0 063 | 0 0015 |
| Totals | | 107 | 57 | 16 | 0 663 | 1 248 | 0 0099 |
| of 1095 Calories | | | | | | | |
| lilk | 360 | 18 | 12 | 15 | 0 432 | 0 334 | 0 0009 |
| leat, fish or chicken | 120 | | 27 | 14 | 0 016 | 0 300 | 0 0040 |
| gg | (1) | | 6 | 5 | 0 033 | 0 090 | 0 0015 |
| read, whole grain | 90 | 48 | 9 | | 0 045 | 0 196 | 0 0021 |
| egetables, 5 per cent | 300 | 12 | 3 | | 0 033 | 0 078 | 0 0012 |
| ruit, 10 per cent | 300 | 33 | | | 0 135 | 0 063 | 0 0015 |
| utter | 15 | | | 13 | 0 002 | 0 003 | |
| Totals | | 111 | 57 | 47 | 0 696 | 1 064 | 0 0112 |
| t of 1200 Calories | | | | | | | |
| lilk | 480 | 24 | 16 | 20 | 0 576 | 0 445 | 0 0012 |
| leat, fish or chicken | 120 | | 27 | 14 | 0 016 | 0 300 | 0 0040 |
| gg | (1) | | 6 | 5 | 0 033 | 0 090 | 0 0015 |
| read, whole grain | 90 | 48 | 9 | | 0 045 | 0 196 | 0 0021 |
| 'egetables 5 per cent | 400 | 16 | 4 | | 0 044 | 0 104 | 0 0016 |
| ruit 10 per cent | 300 | 33 | | | 0 135 | 0 063 | 0 0015 |
| utter | 15 | | | 13 | 0 002 | 0 003 | |
| Totals | | 121 | 62 | 52 | 0 851 | 1 201 | 0 0119 |

* Normal mineral requirement for an adult calcium, 0 68 Gm , phosphorus 1 32 Gm , 1 0015 Gm per day

Sample Menu for One Day

| Morning | Noon | Night |
|---|---|---|
| Diet of 356 Calories | | |
| ⅔ ounce cottage cheese | 1½ ounces meat or fish | ½ ounce cottage cheese |
| ½ slice bread | 1 serving vegetable | 1 serving vegetable |
| ½ glass skimmed milk | ¼ glass skimmed milk | ½ slice bread |
| Coffee | 1 serving fruit | ¼ glass skimmed milk |
| | Tea | Tea |
| Diet of 609 Calories | | |
| 1 serving fruit | 2 ounces meat or fish | 1 egg or 1 ounce cheese |
| ½ ounce cottage cheese | 1 serving vegetable | 1 serving vegetable |
| ½ slice bread | ½ ounce cottage cheese | ½ ounce cottage cheese |
| ½ glass skimmed milk | ½ slice bread | ½ slice bread |
| Coffee | ¼ glass milk | ¼ glass milk |
| | 1 serving fruit | 1 serving fruit |
| | Tea | Tea |
| Diet of 800 Calories | | |
| 1 serving fruit | 3 ounces meat or fish | 1 egg or 1 ounce cheese |
| ½ ounce cottage cheese | 1½ servings vegetable | 1½ servings vegetable |
| 1 slice bread | ½ ounce cottage cheese | ½ ounce cottage cheese |
| ½ glass skimmed milk | 1 slice bread | 1 slice bread |
| Coffee | ¼ glass skimmed milk | ¼ glass skimmed milk |
| | 1 serving fruit | 1 serving fruit |
| | Tea | Tea |
| Diet of 1095 Calories | | |
| 1 serving fruit | 4 ounces meat or fish | 1 egg or 1 ounce cheese |
| 1 teaspoon butter | 1½ servings vegetable | 1½ servings vegetable |
| 1 slice bread | 1 teaspoon butter | 1 teaspoon butter |
| ½ glass milk | 1 slice bread | 1 slice bread |
| Coffee | ½ glass milk | ½ glass milk |
| | 1 serving fruit | 1 serving fruit |
| | Tea | Tea |
| Diet of 1200 Calories | | |
| 1 serving fruit | 4 ounces meat or fish | 1 egg or 1 ounce cheese |
| 1 teaspoon butter | 2 servings vegetables | 2 servings vegetables |
| 1 slice bread | 1 teaspoon butter | 1 teaspoon butter |
| ½ glass milk | 1 slice bread | 1 slice bread |
| Coffee | ½ glass milk | 1 glass milk |
| | 1 serving fruit | 1 serving fruit |
| | Tea | Tea |

The *Karell milk cure*[14] is simply a subcaloric, low salt regimen the benefits of which are the same as those of the diets just described In the strict form the diet permits four glasses of milk (800 cc) in the twenty four hours and no other food, little additional fluid is given After about four days the amount of milk should be increased to 1000 cc, and other simple foods (soft boiled eggs toast with unsalted butter and preserves, and cereals with cream) should be added The patient should remain in bed during the continuance of the Karell diet and should be under close observation Occasionally this procedure brings about definite improvement in cardiac efficiency with rapid disappearance of the edema I doubt, however, that it has any advantages over the other low caloric, salt poor diets that have been discussed here

**Beriberi Heart** The beriberi heart resembles any other type of degenerative heart disease Its frequency and the criteria for its recognition were discussed in the section dealing with thiamine (see p 256) In all the cases reported by Blankenhorn and his associates[15] evidences of nutritive failure not only of thiamine but of other substances also were apparent Thiamine should always be given but the clinicians just quoted report that except in one instance the response to intravenous administration of this vitamin was not dramatic A liberal broad diet in which are included fruits green vegetables meats milk eggs and yeast is appropriate

Atherosclerosis Atherosclerosis has its inception in childhood after adolescence it is present at least in some degree in almost everyone Man is apparently handicapped by an inherent susceptibility to this disease Because of the accumulation of cholesterol and other lipids in the atherosclerotic lesions of certain arteries notably the aorta and the coronary arteries the effort is being made to associate this disease with hypercholesterolemia In rabbits atherosclerosis has been produced by repeated injections of cholesterol and in dogs by the administration of enormous amounts of this substance with the addition of thiouracil A wealth of data deals with studies of this sort These experiments are impressive but *they are carried out under conditions that have no exact counterpart in man* The marked and sustained hypercholesterolemia which is essential in animal experiments is not an invariable accompaniment of the development of arteriosclerosis in man One reviewer[16] aptly comments that it would be hazardous to draw too close an analogy between the mechanism of experimental arteriosclerosis and that of the clinical disease

In the majority of instances of arteriosclerosis in man no evidence of hypercholesterolemia or other disturbances of lipid metabolism can be detected It is possible however that the fault is not necessarily in the total plasma cholesterol but rather in some related metabolic disorder the presence perhaps of abnormal cholesterol containing proteins such as are seen in the recently described giant lipoprotein molecules[17] Keys[17a] concludes from his studies that these giant molecules and total cholesterol both show a distinct tendency to be maintained in higher concentrations in the serum of persons with coronary disease than in those who are clinically healthy but he does not believe that either measurement is a good discriminator between such patients and healthy persons Barr and his associates[18] conclude that future attempts to relate the lipids of the plasma to the deposition of lipids in the tissue must take into consideration their combination with protein This physicochemical problem and related questions are being widely studied but they are yet unsolved

Because of the possible influence that cholesterol may thus play in the development of arteriosclerosis diets low in this substance have been proposed Such diets may eventually prove to be of value but there are good reasons today for adopting a conservative attitude toward them (*a*) the influence of hypercholesterolemia has not been demonstrated (*b*) cholesterol is formed in intermediary metabolism from many sub

stances, and any dietary constituent even carbohydrate, may act as its precursor, and (*c*) since dietary cholesterol is found in animal foods of great nutritive value (eggs, meat, milk), it would seem unwise, unless the usefulness of this procedure is clearly established, to interdict the consumption of such foods For the use, however, of these who wish to limit the patient s intake of this substance a summary of the cholesterol content of foods is provided in Table 119 Cholesterol is absent from plant foods

**Table 119 Cholesterol Content of Foods***

| *Food* | Total Cholesterol mg /100 gm *Moist Food* | Food | Total Cholesterol mg /100 gm |
|---|---|---|---|
| *Muscle meat* | | Egg products | |
| Beef round (medium fat) | 125 | Egg yolk | 2000 |
| Beef round (lean) | 95 | Fresh whole egg | 468 |
| Veal shank | 140 | *Dairy products* | |
| *Veal breast* | 100 | Fresh Jersey milk | |
| Pork spareribs | 105 | (3 7% fat) | 24 |
| Rabbit | 50 | Fresh Holstein milk | |
| Chicken (light) | 90 | (2 5% fat) | 19 |
| Chicken (dark) | 60 | Butter | 280 |
| Duck | 70 | Cheese American | 160 |
| Pigeon | 110 | Cheese Swiss processed | 145 |
| Variety meats | | Cheese Monterey Jack | 190 |
| Liver | | Casein raw | 65 |
| Lamb | 610 | Fish and seafood | |
| Pork | 420 | Oysters eastern | 230† |
| Beef | 320 | Oysters California | 280 470† |
| Calf | 360 | Crab | 145† |
| *Heart (beef)* | 145 | *Tuna*‡ | *149 172* |
| Kidney (beef) | 405 | Mackerel‡ | 240 |
| Sweetbread | 280 | Sardines‡ | 190 |
| Tripe | 150 | Codfish | 50 |
| | | Salmon | 60 |
| | | Shrimp | 150 |
| | | Turtle | 70 |
| | | Brewer s yeast dry | 680† |

* ent of Foods
Okey
† cholesterol.
‡ Data of E Geiger J A M A *139* 194 1949

Of more convincing importance today in the prevention of atherosclerosis is the control of obesity *In his studies* of over 1000 cases Wilens[19] found arteriosclerosis to be about twice as common in the obese as in the poorly nourished group Obesity is a widely prevalent disease and is often devastating in its effects Obese patients with arteriosclerosis become much more comfortable, and life expectancy is increased, after the body weight has been reduced Moderation in everything is demanded The patient should have a well balanced diet which carries an abundance of green vegetables and a reasonable amount of meat (one average helping from four to seven times weekly) He may

take one or two eggs each day This is designed to allow an average protein intake of 60 to 100 gm daily

**Essential Hypertension** Essential hypertension has been defined as a functional disorder characterized by a progressively increasing elevation of both systolic and diastolic arterial pressures As the disorder progresses, however, it gradually loses its functional nature, and in the course of time it is accompanied by structural changes in the arterioles These changes lead in turn to alterations in the heart, kidneys and other organs which last come finally to dominate the clinical picture

Many regimens for the cure or amelioration of this disease, each including some form of dietary restriction have been tried, but none of these has been specific Each has been based on the assumption that one or another element of the diet is harmful to the hypertensive patient but in no instance has the truth of this assumption been finally demonstrated It is necessary to recognize first, that the cause of this disease is still unknown Some of its late effects are well understood but treatment addressed merely to these effects probably does no lasting good Second this is a disease, not of months or years but of decades A diet that fails for long periods to meet the patient s nutritive needs will probably hasten disaster

In attempting to evaluate the diets used in this disease due consideration must be given to the influence of the emotions Shroeder[20] in his review of the pathogenesis of hypertension emphasizes the importance of repressed psychic disturbances of a more or less specific nature which lead to increased activity of the sympathetic nervous system and states that this may in itself raise blood pressure acutely or *may lead to a renal ischemia that results in the production of pressor* substances He aptly concludes that variations in the degree of these causative influences with or without such contributory factors as renal and endocrine diseases and arteriosclerosis explain the wide variations seen in the course of the disease and may account for the relative efficiency or inefficiency of the various methods of treatment It was of the manifold nature of influences of this kind no doubt that Watkin and his associates[21] wrote when they summarized the precise data obtained from their carefully conducted long continued studies with the statement that the response of individual patients with hypertension to hospitalization is so variable and unpredictable that a prolonged period of observation is prerequisite to valid appraisal of the specific effects of therapy

*Sodium restriction* is widely recommended[22] Proponents of this diet assume that there is a disturbance in sodium metabolism In the arrangement of the diet all foods even bread and butter, are prepared without salt no salt is added after the food comes to the table and no food which contains appreciable amounts of sodium is permitted Even fresh milk is prohibited in the most rigid restriction to permit the patient the benefits of this valuable food a sodium free milk powder has been placed on the market The proponents of this diet claim that halfway measures will not suffice and that a diet which is merely salt poor is of no value The food must contain less than 0 2 gm daily of

sodium Such a diet, rigidly observed and long continued, is sometimes accompanied by depression of urinary output with eventual renal failure [22a] It may therefore be distinctly hazardous

As a result of this regimen a lowering of blood pressure is frequently accomplished, but the ultimate significance of this in altering the natural history of essential hypertension is yet to be observed Nevertheless, a low sodium regimen has many adherents Accordingly, tables of the sodium content of foodstuffs, of municipal water supplies and a list of low sodium prepared foods are included in the Appendix (Tables 140, 141, 142), and the following low sodium diets are presented

**Table 120 Typical Food Chart for One Day, Low-Sodium Diet (Approximately 200 mg)**

All food is prepared and cooked without salt, soda and baking powder Canned vegetables should be packed without salt Salt substitute may be used

Type Diet

Breakfast

- Grapefruit juice ½ cup or grapefruit half
- Egg Include about 4 a week
- Unsalted bread—1 slice *or* unsalted cooked cereal *or* ½ Shredded Wheat Biscuit *or* 1 cup Puffed Wheat or Puffed Rice
- Unsalted butter or margarine—2 tablespoons or more
- Sugar and jelly (no preservative) —at least 2 tablespoons
- Coffee or tea

Noon or Evening Meal

- *Unsalted lean cooked meat—about 2 ounces, 1 piece 2½" x 2½" x ½"*
- Unsalted vegetable (see list) —½ cup—sodium 20 mg
- Unsalted potatoes—½ cup—sodium 24 mg
- Unsalted bread—1 slice
- Unsalted butter or margarine—at least 2 tablespoons
- Fruits (see list) —½ cup—sodium 10 mg
- Sugar and jellies (no preservative) at least 2 tablespoons
- Coffee tea or koolade if desired

Evening or Noon Meal

- [illegible] fish—about 2 ounces 1 piece 2½" x 2½" x ½" sodium 20 mg
- Unsalted bread—1 slice

Vegetable List

| Group I (1 cup) | Group II (¾ cup) | Group III (½ cup) | Group IV (¼ cup) | Omit | |
|---|---|---|---|---|---|
| Parsnips | Asparagus | Green beans | Cabbage | Beans | Kohlrabi |
| Squash | Cucumber | Broccoli buds | Lettuce | Beets | *Pumpkin* |
| | Eggplant | Peas fresh | Cauliflower | Carrots | Spinach |
| | Onions | Tomatoes | Sweet corn | Chard | Turnips |
| | *Tomato juice* | *Potatoes* | Turnip greens | Dandelion greens | Peas dried |
| | | Sweet potatoes | | Kale | *Watercress* |
| | | | | | Radishes |

Fruit List

| Group I (1 cup) | Group II (½ cup) | Group III (⅓ cup) | Group IV (¼ cup) | Omit |
|---|---|---|---|---|
| Blackberries | Apple | Blueberries | Currants dried | Avocado |
| Cherries | Currants fresh | Huckleberries | Currants | Banana |
| Cranberries | Figs fresh | Lemons | Watermelon | Cantaloupe |
| Grapefruit | Gooseberries | Peaches | Rhubarb | Cocoanut |
| Grapefruit juice | Grapes | Pineapples | | Dates |
| Loganberries | Oranges | | | Figs dried |
| Plums | Pear | | | Raisins |
| | Persimmon | | | |
| | Strawberries | | | |

(Allowance should be made for the sodium content of the water if known)

(From Rice T R Low Sodium Diet by permission of the author and of Lea & Febiger Publishers)

*Sodium free* salt substitutes are frequently used to improve the palatability of 'salt free' diets A lithium containing product of this kind had serious untoward effects and has been removed from the market The salt substitutes now being offered are believed to be relatively safe, but since they are intended for prolonged use a certain amount of caution should be exercised Those which are most desirable as a salt substitute contain considerable potassium which may be harmful in the presence of serious renal impairment Others which contain ammonia may affect the bronchial mucosa [22b]

**Table 121 Directions for "Sodium Free" Diet** (From Grollman[2"])

No salty foods should be eaten All foods including bread must be prepared without salt unsalted butter must be used *Avoid* the following foods

| | | |
|---|---|---|
| Avocado | Cheese | Pickles |
| Bacon | Dandelion | Preserved meats |
| Barley | Dry cereals unless especially processed | Pretzels |
| Beans—lima | Haddock | Relishes |
| Beets | Ham | Salted bread |
| Buckwheat | Kidney | Salted butter |
| Canned soups | Milk | Salted crackers |
| Canned vegetables | Olives | Salted nuts |
| Celery | Onion | Salad dressings |
| Chard | Oysters | Sea foods |

The sodium free skim milk powder now on the market may be used

Drugs that contain sodium such as bicarbonate of soda and sodium phosphate should be avoided

Dialyzed Milk*

A quart of milk contains over 0 5 gm of sodium which must be removed if it is to be used in a sodium restricted diet This can be done by placing regular milk in a semi permeable membrane around which a steady stream of water circulates For this purpose visking tubing (obtainable from the Visking Corporation Chicago) may be used One end of an approximately 5 ft length of tubing is tied off and the milk introduced through the open end which is then also tied and the filled tube placed in a cylinder through which water circulates Dialysis must continue for approximately 48 hours and the circulating water must be maintained at a low temperature in order to avoid spoilage A dried milk powder which has been freed from its sodium content has been prepared commercially

* From Queries and Minor Notes J A M.A *131* 366 1946

The *rice diet* advocated by Kempner[23] warrants the same generalizations as the diets given for sodium restriction The drops in blood pressure that occur during this regimen are generally credited to the low sodium intake rather than to the extremely low protein quota of the diet In the studies of Schwartz and Merlis[24] it was found to result in a negative nitrogen balance, and more recently a report from Duke University[24a] tells of five slightly negative and several slightly positive balances in a small group of patients Negative nitrogen balances, long continued, are always hazardous, and in addition there may be other harmful effects[25] The difficulties of control are great, almost prohibitive This was the conclusion of Watkin and his co workers at Columbia University,[21] who, after careful studies, wrote that the continued maintenance of the Kempner regimen as now prescribed imposes such hardship on the patient and such difficulty of control as to make it virtually impossible for general use Opinions differ, and the good results reported by Kempner await further confirmation

Kempner advises as follows The rice diet contains 2000 Calories not more than 5 gm of fat, and about 20 gm of protein derived from rice and fruit, and not more than 200 mg of chloride and 150 mg of sodium A patient takes an average of 250 to 350 gm of rice (dry weight) daily, any kind of rice may be used, provided no sodium chloride, milk, or the like has been added during its processing The rice is boiled or steamed in plain water or fruit juice, without salt, milk or fat If the sodium concentration of the plain water available is greater than 20 mg per liter, distilled water should be used All fruit juices and fruits are allowed, with the exception of nuts dates, avocados and any dried or canned fruit or fruit derivatives to which substances other than white sugar have been added Not more than one banana a day should be taken White sugar and dextrose may be used *ad libitum*, on an average patient takes about 100 gm daily, but if necessary, as much as 500 gm daily should be used Tomato and vegetables juices are not allowed Usually no water is given, and the fluid intake is limited to 700 to 1000 cc of fruit juice per day Supplementary vitamins are added in the following amounts vitamin A, 5000 units, vitamin D, 1000 units, thiamine chloride 5 mg, riboflavin, 5 mg, niacinamide, 25 mg, calcium pantothenate, 2 mg No other medication is given unless it is specifically indicated

During the first period of 'regulation on the diet, the patient should be under constant medical supervision and blood and urine chemistry should be checked frequently Rest in bed unless the severity of the condition demands it, is neither necessary nor desirable

*Starvation* or *semistarvation*, without particular reference to protein, sodium or any other single element of the diet, will as a rule bring a reduction in blood pressure This applies to normal persons as well as to those with hypertension particularly to the obese The effects of a diet of this kind have been described by Brozek and his associates[26] in a report of their experiments upon a group of healthy young men, and it is noteworthy that these observers sometimes saw untoward,

serious effects From their studies and from reports of other investigators these observers conclude that the decline in blood pressure that accompanies semistarvation in normal young men is a reversible process, and that when nutritive equilibrium is reestablished the pressure not only returns to normal, but may at times overshoot the mark to frankly hypertensive values In confirmation of this these physicians quoted reports of similar observations made in Leningrad After the famine of the war period, hypertension in that city became during the ensuing two years a serious problem During the period of recovery from semistarvation not only was there a greatly increased incidence of hypertension, but there were indications that the disease was present in severer forms than previously

Rigid limitation of the caloric intake will bring a fall in blood pressure in hypertensive patients, but it has not yet been proved that this fall is accompanied by a favorable change in the underlying disease process Also from the reports just quoted, the conclusion seems warranted that once the hypertensive patient is on a semistarvation regimen he may later, when dietary restrictions are abandoned, find himself in a more grievous state than before treatment was instituted All this causes the physician to pause when he contemplates placing his patient upon the sodium free diet the rice cure, or any other regimen of rigid dietary restriction

The consensus, however, as expressed in the review of Kahn and Stare,[27] is that with due consideration of the hazards involved the low sodium diet or the "rice cure offers a degree of promise to certain groups of patients, notably those who require more than reassurance, weight reduction or mild sedation These diets may justifiably be given a trial in cases of severe hypertension, particularly of the malignant form, provided the patient is prepared to live by the rule and understands the hazards of the regimen The cases should be carefully selected, and, for reasons just discussed, there should be no sudden return to an abundant diet or other abrupt changes in the regimen For the hypertensive patient whose extremity is less desperate, a less radical diet fraught with fewer hazards should be instituted

When a better understanding of the intricacies of essential hypertension has been obtained a surer dietary approach to the disease will probably be seen, but there is no clear approach today The advice of Page[28] to wait until investigators have arrived at a solid conclusion before recommending wide changes in your patient s diet' is good Until the way is clearer, therefore, it can properly be assumed that the best diet for the patient with hypertension is one that, while throwing the smallest burden on his metabolism, will preserve his strength and vigor for the longest period

*Moderation in diet* is best for the average patient The person whose weight is normal should gradually reduce some 10 per cent, the obese person to a figure which approximates but not necessarily equals, his ideal weight (Table 134 Appendix) The diet should be moderately subcaloric but balanced For the moderately active person 2000 Calories

are as a rule proper When the patient does not lose weight on this allowance it often means that he is eating more than he admits The greatest restriction should be of fatty and starchy foods

There is no valid reason why the protein of the diet should be rigidly restricted Protein foods do not cause elevation of the blood pressure It is true that in rats deprived of 80 per cent or more of their renal tissue the amount of protein in the ration has been shown to be influential in raising the blood pressure but except in advanced disease of the kidneys this is not applicable to man Not until the hypertensive disorder is far advanced and there is serious impairment of renal function is there reason for restriction of the intake of protein To preserve a sense of well being and a maximum of vigor the patient should receive enough protein to meet all nutritive requirements This contemplates an allowance of 60 to 70 gm daily of protein of high biologic value in which should be included the proteins of meat milk and eggs

Carbohydrate and fat should be eaten in amounts sufficient to bring the total caloric value of the diet to the maintenance figure At least 50 per cent of the energy should be in the form of carbohydrate The need for vitamins and minerals should be kept always in mind The patient should take an abundance of fruits and green vegetables and always some milk

Water balance in arterial hypertension has been much discussed because it was once thought that rigid restriction of fluids would lower the blood pressure This is not true nor will the drinking of liberal quantities of water raise the blood pressure It seems best therefore to permit the patient a reasonable amount of fluid such an amount as his appetite and thirst demand provided of course his appetite in this respect is not grossly abnormal From 1500 to 2000 cc of total fluids is appropriate for the average adult in summer and especially in warm climates this should be increased

It is customary although the consistency of this may be open to question to advise that no salt be added to the food after it comes to the table and that no unusually salty food be eaten When the desired weight loss has been accomplished then the food allowances should be readjusted to form a maintenance diet

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# 24

## *Diseases of the Blood*

The nutritional relationships of diseases of the blood require but little comment No specific type of dietary therapy has been demonstrated to alter the course of hematologic disorders other than certain anemias Hence except in the latter, diet therapy consists merely in the pro vision of an adequate dietary such as was discussed in Chapter 11 Alterations in the physical character or the modes of administration of the diet may be demanded by the severity of the illness or by some complication of the disease

**The Anemias** The anemias which respond to nutritional factors are of two major types (1) the microcytic hypochromic anemia associated with normoblastic hyperplasia of the bone marrow and which responds to the administration of iron, and (2) the macrocytic anemias asso ciated with megaloblastic hyperplasia of the bone marrow and which respond to the newer hemopoietic factors (vitamin $B_{12}$ and folic acid), or the so-called group of liver extract factors These anemias include pernicious anemia, sprue, pernicious anemia of pregnancy, trop ical macrocytic anemia, the macrocytic anemia associated with celiac disease nutritional macrocytic anemia, megaloblastic anemia in infancy and other similar anemias Effective therapy of these disorders must be predicated upon accurate diagnosis and an understanding of the physiologic disorder in each instance Excellent discussions of the diagnosis of these anemias have been provided by several writers no tably Wintrobe[1] and Sturgis[2] and in addition, are presented in modern textbooks of medicine Suffice it to indicate here that the diagnosis is dependent upon the characterization of the size of erythrocytes, of the concentration of hemoglobin in a unit volume of the red cell and upon examination of the bone marrow These several characteristics are summarized in Table 122

***Iron Deficiency Anemia***[4 7] Symptoms associated with the microcytic hypochromic anemia of iron deficiency are easy fatigability anorexia pallor, and a chronic "rundown" feeling In chronic cases particularly in women, a symptom complex known as the Plummer Vinson syn drome may be encountered This consists in dysphagia, soreness of the mouth and tongue sometimes fissures at the angles of the mouth and psychoneurosis Any one of the components of this symptom complex may occur in absence of the others Koilonychia thin, brittle, spoon

Table 122 *Classification of Principal Anemias* (Modified after Wintrobe[3])

| Anemias | MCV (Cu μ) | MCHC (%) | Syndrome | Characterized by | Responds to |
|---|---|---|---|---|---|
| ochromic microcytic | < 80 | < 30 | Iron deficiency anemias, including dietary deficiency, excessive blood loss, hookworm infestation and repeated pregnancies | Low serum iron, normoblastic marrow | Iron and correction of blood loss |
| ple microcytic | < 80 | > 30 | Subacute and chronic inflammatory diseases | Low serum iron, hypercupremia | Treatment of cause |
| mocytic | 80–94 | > 30 | A Myelophthisic and aplastic anemias, chronic disease | | Transfusion and treatment of cause |
| | | | B "Physiologic" anemia (hydremia) of pregnancy | | |
| rocytic | > 94 | > 30 | A Pernicious anemia<br>Sprue<br>Pernicious anemia of pregnancy<br>Macrocytic anemia of celiac disease<br>Nutritional macrocytic anemia<br>Tropical macrocytic anemia<br>Macrocytic anemia associated with conditions such as carcinoma of stomach and liver disease | Megaloblastic marrow, high or normal serum iron | Liver extract, folic acid, vitamin $B_{12}$ or animal protein factor |
| | | | B Conditions usually associated with normocytic anemias | | Transfusions and treatment of causes |

shaped fingernails may be observed in an occasional case of long standing chronic anemia of iron deficiency

Nonspecific secondary manifestations of anemia which may be seen include amenorrhea in women, various cardiac changes such as enlargement, murmurs, and electrocardiographic abnormalities, and, in rare patients, cardiac pain indistinguishable from that which occurs in angina pectoris Achlorhydria is often observed in iron deficiency anemia, but a causative relationship of this secondary abnormality remains to be established

*The hemoglobin level* in iron deficiency may range from a slightly submaximal value to a concentration barely compatible with life The erythrocyte count is usually above 3 million per cubic millimeter, and there is a relatively greater decrease in the volume of the packed red cells than in the number of erythrocytes The changes in blood indices indicated in Table 122 may be confirmed by the appearance of the erythrocytes upon examination of a stained smear No reticulocytosis is observed unless recent acute blood loss has occurred or iron therapy has been instituted *The bone marrow shows a definite increase in the number of normoblasts*, which finding is in contrast to the megaloblastic hyperplasia observed in pernicious anemia The concentration of iron in the blood serum is reduced below the lower limit of the normal level of some 80 micrograms per 100 cc

*Iron deficiency anemia occurring in adults should be considered evidence of current or past blood loss* Accordingly, careful inquiries and examination should be made for menorrhagia bleeding hemorrhoids peptic ulcer, repeated epistaxis, or other sources of chronic blood loss

In children there usually occurs no evidence or history of blood loss, although in some regions of the world parasitic infestation may be found, especially in iron deficiency in children [8] In the absence of parasitic infestation or the rare case of blood loss in infants iron deficiency is to be regarded as of dietary origin in this age group The larger requirements for iron during periods of rapid growth coupled with the essentially iron free diet which results when an unsupplemented milk feeding regimen is adhered to make this possible Such an origin accounts for most cases encountered in the age group of six months to two or three years

In infants and children, hypochromic microcytic anemia of iron deficiency is not frequently associated with mucosal changes or koilonychia Instead the predominant findings are pallor, listlessness anorexia and failure or retardation of growth

**Prevention of Iron Deficiency** The best treatment of iron deficiency anemia is prevention *Prevention is feasible in infancy* because of the dietary nature of the disease It is accomplished by insuring that the infant is born with adequate stores of iron through ascertaining during the period of prenatal care that there is no iron deficiency in the pregnant woman and thereby providing optimal circumstances for the transference to the fetus of good iron stores Secondly, the early institution of supplemental feedings of such iron rich foods as egg yolk, leafy vege

tables fruits cereals, potatoes and meat will serve to prevent iron deficiency in infants (see Chap 12)

In adults, the prevention of iron deficiency which results from chronic blood loss may not be possible by diet alone because of the magnitude of the blood loss or the failure of the patient to consult the physician early during the course of the disease process Nevertheless, provision of an adequate diet which contains ample quantities of iron rich foods is desirable as a general therapeutic measure In instances in which chronic blood loss is recognized, but remains uncorrected for a period of time, the physician can prevent the occurrence of severe hypochromic anemia by preventive therapy with a source of iron, such as ferrous sulfate

Treatment Once iron deficiency anemia has developed, the treatment consists in the administration of adequate quantities of an effective iron preparation, such as ferrous sulfate, 0 3 gm three times daily, coupled with the simultaneous correction of the blood loss At the same time, any recognized poor dietary habits of the patient should be corrected in order that he obtain a good normal diet

It is important that therapy be continued for a sufficient period of time to allow the return of hemoglobin levels to the maximum for the individual This usually requires two to three months of therapy Furthermore, it is essential that the cause of excessive iron loss that is, the chronic blood loss, be corrected for otherwise the patient will relapse after therapy is interdicted Relapse following cessation of iron therapy is relatively common in instances of untreated excessive menstrual bleeding or hookworm disease

After the institution of iron therapy, clinical improvement is manifest within a few days When the mucosal changes of iron deficiency are present, they are usually relieved within a week or ten days [9,10] The nail changes i e, koilonychia, disappear only as new, normal nails grow out from the base

A reticulocytosis occurs about the sixth to tenth day of treatment and is the first hematologic evidence of response to iron therapy The maximum reticulocyte response is less than that observed following specific therapy of pernicious anemia and is related to the pretreatment hemoglobin concentration The subsequent hemoglobin regeneration increases on an average of approximately 0 1 to 0 3 gm per 100 cc per day in adequately responding cases

The evidence is unconvincing that such supplementary factors as liver extract yeast other sources of B vitamins copper molybdenum other minerals or hydrochloric have any therapeutic advantage over simple iron preparations such as ferrous sulfate, in the ordinary cases of iron deficiency anemia Iron exhibits a hemopoietic activity only in instances of iron deficiency anemia, and hence will not be effective in anemias of infection the anemias accompanying nitrogen retention, in the treatment of pernicious anemia or other macrocytic anemia Furthermore, unless there are changes in blood indices consistent with the diagnosis of iron deficiency, one does not need to administer iron during pregnancy

There is sound evidence which indicates that ferrous iron is better absorbed by the human being than is ferric iron[11,12] Iron preparations containing 'organic iron' have no therapeutic advantage, indeed in some instances, such iron may have low physiologic availability

Gastrointestinal symptoms of nausea, anorexia or diarrhea have been ascribed to the administration of therapeutic doses of iron In the authors' experience, these symptoms are encountered infrequently When encountered, they may be avoided by either the administration of medication after or during meals or, in some instances, by the initiation of therapy with small doses, followed by gradually increasing the amount until the full therapeutic dose is attained Unpublished studies by one of the authors indicate that smaller doses of ferrous sulfate than are commonly given may promote equally good hemopoiesis in iron deficiency anemias[13] Accordingly, if gastrointestinal symptoms are troublesome, the dose of ferrous sulfate may be reduced to as low as 100 mg and still be therapeutically effective, provided the blood loss be interdicted

## PERNICIOUS ANEMIA

Pernicious anemia is characterized by the findings of macrocytic anemia with mild leukopenia and associated hypersegmentation of the polymorphonuclear leukocytes, megaloblastic hyperplasia of the bone marrow, glossitis histamine fast achlorhydria, and neurologic signs of combined involvement of the posterior and lateral columns of the spinal cord It is the exceptional case which exhibits all these findings, and any combination of them may be encountered Perhaps the least absent finding is that of a macrocytic anemia with megaloblastic hyperplasia of the bone marrow Gastrointestinal symptoms of indigestion anorexia and resultant weight loss may be seen

*Etiology* Pernicious anemia is due to the absence of Castle s intrinsic factor[14] It is now recognized that this factor, present in normal gastric juice, favors the absorption[15,16] of those quantities of vitamin $B_{12}$ which may reasonably be expected to be encountered in the usual normal diet Accordingly, it seems reasonable to regard pernicious anemia as a deficiency disease conditioned by inability to absorb vitamin $B_{12}$ Whether this simplified view of the disease is entirely adequate cannot be determined at the moment, but it provides an excellent key to understanding the rationale of therapy

*Treatment* Within the lifetime of many patients still living with pernicious anemia the therapy of their disease has undergone a number of evolutionary changes It was early recognized that large quantities of liver in the diet had a beneficial effect on the course of pernicious anemia and this recognition was the basis of the liver diets successfully used for control of pernicious anemia[17] It is now apparent that these diets serve as a source of great quantities of vitamin $B_{12}$ and some folic acid as well as abundant supplies of other vitamins and protein The diets supply sufficient $B_{12}$ that even with the inefficient absorption of the factor because of the absence of intrinsic factor some of the vitamin passes the gastrointestinal barrier promotes hemopoiesis and affords protection to the nervous system against further extension of the com

bined system disease. It has recently been demonstrated that large quantities of vitamin $B_{12}$ administered by mouth may be effective in the treatment of pernicious anemia. The quantities required, however, vary greatly with the patient and are large, indeed, in contrast to the small doses effective upon parenteral administration. Thus the effective oral dose may vary upward from 60 to around 1000 micrograms per day, while effective parenteral therapy with vitamin $B_{12}$ does not require quantities greater than 2 micrograms per day.

Modern developments have rendered unnecessary the use of the liver diets in the treatment of pernicious anemia. The reader who wishes to find a discussion of such diets is referred to earlier editions of this book.

Extracts of liver suitable for parenteral administration have long been used most satisfactorily in the treatment of pernicious anemia. In general, these extracts may be classified as crude (which usually contain 2 units per cubic centimeter) or concentrated (which contains 10 to 15 units per cubic centimeter). Such preparations have proved highly satisfactory in controlling pernicious anemia. They should be administered in quantities supplying a maintenance dose which averages at least 1 unit per day. Contrary to earlier impressions, there seems to be no advantage to the crude liver extracts over the more highly refined preparations. Since the purified preparations can be given in quantities supplying several times as many units per volume, they are much more convenient and are less painful of administration than are the crude extracts. Satisfactory treatment schedules as follows have been used in the hematologic clinic of Vanderbilt University for a number of years: A period of initial therapy of ten to fourteen days, during which parenterally administered purified liver extract is given in such quantity to supply 10 to 15 units of antipernicious anemia activity per day, is followed by maintenance of the patient with concentrated liver extract parenterally administered at intervals of two to four weeks in quantities furnishing 1 to 2 units of activity per day.

The evidence to date indicates that vitamin $B_{12}$ is effective maintenance for patients with pernicious anemia and protects the patient against the development of neurologic damage. For clinical purposes, it may be assumed that 1 microgram of vitamin $B_{12}$ is the approximate equivalent of 1 unit of liver extract activity, and dosage may be planned accordingly. Thus a satisfactory treatment schedule for patients with pernicious anemia with vitamin $B_{12}$ would consist in administering 10 to 15 micrograms of vitamin $B_{12}$ parenterally per day for a ten- to fourteen-day interval. Subsequently, maintenance at a level of 15 to 30 micrograms parenterally every two to four weeks is required.

*The time-tested satisfactory handling of patients with liver extract preparations is still an effective, dependable method of treatment of pernicious anemia.* The evidence to date indicates that vitamin $B_{12}$ is also satisfactory for the management of such patients. The primary advantages of vitamin $B_{12}$ are those of convenience. There is somewhat less pain at the site of injection of solutions of crystalline vitamin $B_{12}$ than may be experienced with some of the liver extract preparations, and sensitivity reactions do not occur with vitamin $B_{12}$.

Ungley[18] has recommended that the period of intensive initial therapy with vitamin $B_{12}$ in the treatment of pernicious anemia is unnecessary. He has found that doses of 5 to 160 micrograms administered parenterally as a single dose induces a remission. Erythrocyte regeneration in this dosage range was proportional to the logarithm of the dose.

Although experimental preparations of intrinsic factors have been shown to potentiate orally administered vitamin $B_{12}$, such preparations are not yet available for clinical use. The claim that folic acid potentiates the activity of vitamin $B_{12}$ in a manner similar to that of intrinsic factor has not been substantiated and is not accepted by most hematologists. Accordingly, the parenteral route of administration of effective antipernicious anemia factors remains the route of choice.

Although folic acid will produce a hematologic remission in patients with pernicious anemia, it should not be used as the sole agent of treatment, because it fails to protect against the development of neurologic disease in this condition. When adequate amounts of vitamin $B_{12}$ or of liver extract are administered, it does not appear that folic acid has been demonstrated to improve the therapy of pernicious anemia.

With the development of reliable preparations of the antipernicious anemia factor the need for special diets in the disease has disappeared. The patient with pernicious anemia should be advised to eat an adequate, normal diet.

Maintenance therapy of patients with pernicious anemia must be continued throughout life, inasmuch as the absorptive defect is a permanent one and, accordingly, a relapse will occur if therapy is interdicted. It has been demonstrated that long periods, even extending into a number of years, may be required for the occurrence of such a relapse,[19] but the time interval before the appearance of the relapse is unpredictable and should not allow either the physician or patient to feel that regular therapy is unnecessary.

## SPRUE[20-23]

Sprue is a disease characterized by a macrocytic anemia, leukopenia and associated megaloblastic hyperplasia of the bone marrow. In addition, there are numerous evidences of alterations in absorption from the gastrointestinal tract. Especially prominent are the evidences of impairment of lipid absorption: steatorrhea, hypocarotenemia, hypoprothrombinemia due to vitamin K deficiency, and impaired absorption of vitamin A as measured by the oral vitamin A tolerance test. In addition, studies may reveal decreased serum levels of tocopherols and a lowering of the tocopherol absorption curve. Roentgenologic examination of the small intestine reveals the so called deficiency pattern, which is associated with clumping and puddling of the barium and the disappearance of the normal feathery appearance of the small intestine.[24] A flat oral glucose tolerance curve indicates impairment of absorption of water soluble factors. Hypocalcemia, sometimes associated with tetany, is often attributable to impairment of absorption of both calcium and vitamin D. Hyperpigmentation of the skin may be present. Achlorhydria

may or may not be evident Glossitis is usually observed Neurologic manifestations are seldom, if ever, seen in uncomplicated sprue

The anorexia and faulty absorption in this syndrome account for the profound wasting which characterizes the patient with sprue

Although steatorrhea is a *sine qua non* of sprue,[20] steatorrhea and sprue should not be used as synonyms There are numerous other causes for steatorrhea Indeed, the practice common among gastroenterologists of using the term "sprue" to refer to all steatorrhea of unexplained etiology, regardless of the association with anemia and the other manifestations enumerated, is but confusing *Idiopathic steatorrhea should not be classified as sprue even with the modification "nontropical sprue"* Indeed, as Hanes[20] contended, there is no reason for separating sprue into "tropical" and "nontropical" varieties When the disease presents the manifestations enumerated it is identical, regardless of the geographic setting

Whether sprue is to be considered a dietary deficiency disease is still unsettled There seems little reason to doubt that many cases of sprue have in common a history of a monotonous low protein diet which seems to bear a causative relationship to the disease On the other hand, some patients acquire sprue despite the consumption of what appears to be a satisfactory type of diet

Folic acid exerts a dramatically beneficial effect on most of the defects observed in typical cases of sprue[23 25 26 27] Therapy with this agent in doses of 5 to 15 mg per day, either orally or parenterally, is followed within twenty four to thirty six hours by an improved sense of well being This occurs before any change in the peripheral blood picture Within two to four days, relief of glossitis and beginning regeneration of the atrophic lingual papillae may be noted The number of stools per day decreases, the character of the stool changes toward the normal, darker, formed movement The appetite is increased, and, by the fourth day or so, the patient may exhibit an almost insatiable hunger Rapid weight gain occurs, and, after about a week of therapy, there may be observed a transitory dependent edema Beginning on the third to fifth day, a reticulocytosis develops, the peak of which may be reached between the fourth and twelfth days An increase in erythrocytes, leukocytes, and platelets follows, and the marrow may be seen to shift from the megaloblastic type through a normoblastic phase to the normal marrow as erythrocyte repletion occurs Improvement in absorption from the gastrointestinal tract may be demonstrated, the first laboratory evidence being the increased rise in blood sugar after an oral test dose[25] Later, evidences of improved absorption of lipid and lipid soluble factors may be obtained[26 28] Gradually there usually occur alterations toward normal in the gastrointestinal pattern on roentgenologic examination[26 27]

Vitamin $B_{12}$ is effective in initiating a hemopoietic and clinical response in sprue[29] Critical studies have not been reported which enable one to state with certainty that improvement in gastrointestinal absorption follows vitamin $B_{12}$ administration It is assumed, however, that such is the case, inasmuch as this vitamin alters the diarrhea in patients

with sprue It has long been recognized that liver extract is effective in the treatment and maintenance of patients with sprue[21] There is a prevalent impression that crude liver extracts are more effective in this syndrome than are the highly purified fractions It is not possible to appraise this impression

Maintenance therapy of patients with sprue is desirable, and, in our experience, satisfactory maintenance has been attained by the oral administration of 5 mg of folic acid per day

Vitamin K is another specific factor often indicated in the therapy of sprue When hemorrhagic tendencies are manifest by petechias retinal hemorrhages or other signs or by a significant hypoprothrombinemia the parenteral administration of a vitamin K preparation is essential One to 3 mg of a vitamin K substance, such as menadione, should be given daily for three to five days

The dietary therapy of sprue should be aimed at provision of a high Calorie, high protein and high vitamin diet In some instances the patient is more comfortable if the quantity of fat in the diet is decreased somewhat below the usual intake

With the development of specific therapeutic agents for the treatment of sprue, there has disappeared the necessity for searching for specific types of diets of value in this condition It was formerly held that a number of diets, such as the strawberry diet, were beneficial in the treatment of sprue The use of one of the specific liver extract factors coupled with treatment with vitamin K when indicated and the administration of a diet high in calories, protein, and vitamins and of moderate or low fat content suffices for treatment of most cases of this syndrome The diets indicated under the normal diet or the diets given in Chapter 22 are satisfactory for such patients

The occasional patient with sprue may present himself to the physician at a time when the changes have become irreversible In such instances all types of therapy may be in vain[30,31] Furthermore, it is sometimes impossible to distinguish between cases of true sprue and those of idiopathic steatorrhea Some patients with sprue appear to obtain a reasonably satisfactory hematologic remission and but partial clearing of their gastrointestinal malfunction after therapy In some instances of sprue in partial remission the administration of an emulsifying agent, such as one of the Tweens, may improve lipid absorption Thus Jones and his co workers[32] found that the administration of 4 gm of Tween 80 three times a day was of considerable benefit in restoring fat absorption Not all cases, however, are benefited by this agent

## OTHER MACROCYTIC ANEMIAS

**Nutritional Macrocytic Anemia** Nutritional macrocytic anemia is a term applied to a macrocytic anemia frequently associated with mild gastrointestinal disfunction and often difficult to separate from the sprue syndrome[33] This anemia occurs in patients consuming a monotonous, low protein restricted dietary It is probable that it represents a mild degree of sprue At any rate, therapy is the same as for sprue Responses are usually satisfactory, and maintenance therapy may or may not be

required As in all such anemias an effort should be made to correct the dietary habits of the patient

*Pernicious Anemia of Pregnancy* The megaloblastic anemia which may develop during the latter months of pregnancy or immediately post partum is frequently referred to as pernicious anemia of preg nancy[34] This term is unfortunate inasmuch as the syndrome is not true pernicious anemia Achlorhydria may be present but the primary clinical distinction between this syndrome and true pernicious anemia lies in the absence of neurologic manifestations and the lack of necessity for continued maintenance of the patient after a satisfactory remission has been brought about Therapeutically this disease is distinct from pernicious anemia inasmuch as vitamin $B_{12}$ the agent effective in the treatment of pernicious anemia is ineffective in the therapy of per nicious anemia of pregnancy[35 36] Folic acid appears to be specific for this anemia[36 37 38] It seems probable that folic acid is in fact the agent[36] which was present in the liver fractions early reported by Lucy Wills to be effective in this disease which she studied in India Until additional evidence accrues it would seem reasonable to hold that folic acid is indeed the so called Wills Factor

Treatment of pernicious anemia of pregnancy consists in the admini stration of folic acid 5 to 15 mg per day orally or parenterally coupled with the administration of a normal diet or a modification thereof which the patient s condition demands When this syndrome develops during pregnancy it is desirable to continue therapy with folic acid at a level of 5 mg per day orally until about two months after delivery Treatment can then be discontinued and relapse should not occur The patient should be observed however at intervals for a period of one to two years in order to make certain that the syndrome which developed during pregnancy was not the first manifestation of sprue or some other anemia which is likely to relapse It is a well known fact that sprue not infrequently makes its initial appearance during pregnancy[20]

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# 25

## *Diseases of the Joints*

What should the person with arthritis eat? This is an old question, frequently asked, to which many answers have been given. Current medical opinion would probably hazard the answer that although the patient wishes to be given a special diet and indeed may thereby be benefited, the disease does not require one.[1] The question, however, is not so easily dismissed.

The diets proposed for patients with arthritis are many and varied, some of them based upon a semblance of reason, others entirely fantastic. These have been critically analyzed by Bauer,[1] who pointed out their merits and their fallacies. Regimens based on well considered clinical evidence which are advised for rheumatoid arthritis will be discussed with that disease. Many other diets have been proposed for all forms of arthritis, regardless of type, but these are all apparently without value.

(1) Oldest among the fanciful diets for arthritis is that which omits the so-called acid fruits and vegetables because of a fear of "acidosis." Experience has shown that not only do these foods cause no harm, but, because of the vitamins and minerals provided, they are much needed. (2) Similar reasoning, based on an erroneous belief in an "acid tendency" in arthritis, has endeavored to focus attention on the acid-base properties of the food. This is unnecessary. The body is in possession of a finely adjusted regulatory mechanism which under ordinary circumstances preserves in the body fluids an unvarying reaction. With any reasonable diet there is no need to fear that this balance will be upset. (3) The restriction of protein in arthritis goes back to the days when almost all types of arthritis were believed to be gouty. Clinical experience has not shown that such restriction (except in gout) will do other than merely impair the patient's vigor and sense of well-being. (4) Hypersensitiveness to certain foods is believed to be the occasional cause of chronic arthritis, and dietary systems based on this assumption have been devised, many of which are dangerously one-sided. Anaphylaxis may cause acute swelling of a joint, but its influence in the production of chronic arthritis is doubtful. The relationship of any food to arthritis in a given case can be determined by means of elimination diets, such as were discussed in Chapter 18, but such tests should be repeated twice or more before a final interpretation is made;

even then, caution is needed If it is apparent that the patient is anaphylactic to any food or group of foods, these must be withdrawn from his diet, but care should be taken to see that the general state of his nutrition does not suffer, since great harm can come from a poorly balanced diet Bauer[1] writes that he has never seen a patient with rheumatoid arthritis due to hypersensitiveness

Many classifications of disease of the joints have been offered That given in the third edition of the Primer published by the American Committee for the Control of Rheumatism[2] assumes that the majority of cases fall into the following seven groups

1 Arthritis due to known microbial agents
2 The arthritis of rheumatic fever
3 Rheumatoid arthritis
4 Degenerative joint disease
5 Arthritis due to direct trauma
6 Arthritis of gout
7 The nonarticular forms of rheumatism such as fibrositis and bursitis

The first group, the arthropathies due to known bacterial agents, will be omitted from this discussion any dietary treatment to which they chance to be amenable is that of the underlying disease The same is true of the arthritis due to gout, this has been discussed elsewhere The present discussion, therefore, will be concerned only with the diseases of the second third and fourth groups

The ultimate promise of the recently discovered agents, cortisone and ACTH, is not germane to these discussions [2a]

## RHEUMATIC FEVER

Rheumatic fever is still a disease of somewhat doubtful origin Swift[3] writes that the Streptococcus is probably one of several causative factors and the only one about which we have definite information He believes that consideration must be given, too, to the precursory attuning of the human tissues which will determine the course of the infection It has been repeatedly suggested that there is a host reaction or allergy to this infection [4]

The value of any special form of diet is questionable, but many investigators endeavor to relate rheumatic fever to some form of dietary deficiency Rinehart[5] and Mettier expressed the belief several years ago that lack of vitamin C is a causative factor Encouraging results were reported by Peete [6] who compared the dietary habits of fifty patients with those of twenty five normal persons and concluded that the average diet of the rheumatic patient is deficient in several respects in proteins, in vitamins A and D and in minerals, notably calcium, phosphorus and iron He reported that recurrences of active infection were greatly reduced in number in those patients whose dietary faults were corrected and who in addition, were given cod liver oil Of like tenor were the conclusions of Shank and his associates,[7] who state that there is a statistically significant association between susceptibility to rheumatic fever and an inadequate intake of vitamin A, and further that patients

with rheumatic fever show delayed or decreased absorption of vitamin A or metabolize it in an abnormal manner

Contrary to all this is the opinion of Warner, Winterton and Clark[8] who, in their comparative studies of the food habits of thirty three rheumatic families (including ninety two children) and twenty seven control families saw no significant differences In agreement with the findings of these authors were the observations of Griffin[9] who reported that ascorbic acid does not hasten convalescence from rheumatic fever and that there is no value in the routine use of vitamins Perhaps the answer is that nutritive deficiency results from the anorexia and disease process while good nutrition favors recovery

### RHEUMATOID ARTHRITIS

The cause of rheumatoid arthritis is unknown Chief among the causes to which it has been attributed is infection but faith in this theory is weakening The time has come, according to Cecil and Angevine,[10] for a complete revaluation of the theory of focal infection These authors concluded from their studies that chronic focal infection plays a com paratively unimportant role in the causation of rheumatoid arthritis

The pathologic changes of rheumatoid arthritis lead first to prolifer ation of the synovial membrane and eventually to destruction of the cartilaginous tissue This may involve the capsule and other periarticu lar structures with resulting increased growth of the perichondrium and formation of new bone Roentgenograms at first show very little but later there is clouding of the interarticular space, finally with partial or complete ankylosis This type of arthritis produces pain, swelling and limitation of motion It is usually progressive and may move from joint to joint Typical of this group is arthritis deformans

The *diet* suitable in this form of arthritis has been the subject of no little controversy Two departures from the normal have been advised (*a*) a reduction in the total caloric intake and (*b*) restriction of carbo hydrate In the light of general clinical experience both these pro cedures appear to be of doubtful value

A subcaloric diet for a limited period was recommended by Pem berton[11] and others More recently Scull and Pemberton[12] have sug gested that *disturbances of water distribution constitute significant fac* tors in the dynamic pathologic changes of the rheumatoid syndrome they have seen low caloric diets associated with net loss of water ac *complish clinical improvement* Such a diet reduces the metabolism and is therefore of benefit in conditions in which a low metabolic rate is advantageous as in myocardial failure but except for the obese person its value in chronic arthritis is open to serious question It should be followed only with caution by patients who are underweight and care should be taken always to secure an adequate supply of protein vitamins and minerals With a few notable exceptions students of arthritis have failed to find merit in this regimen

Carbohydrate restriction in chronic arthritis particularly in rheu matoid arthritis was advised by Pemberton[11] Fletcher[13] and others who saw marked improvement follow such restriction This advice was

based in part upon clinical experience and in part upon evidence that changes in the circulation of the blood in and around the inflamed joints interfere with the normal mechanism by which the muscle removes sugar from the blood [14] An additional reason was offered by Fletcher and Graham,[15] who described changes in the contour and behavior of the large intestine in patients with chronic arthritis and reported improvement when a regimen low in carbohydrate and high in vitamins was instituted This delayed sugar removal," cited by the proponents of carbohydrate restriction, and the lowering of the sugar value which is reported to follow such treatment are not, however, generally regarded as significant From repeated studies of the blood sugar curves of the same person, Lennox and Bellinger[16] are not inclined to attribute the lower second curve' to the treatment or to credit it with importance In his study of the sugar tolerance of arthritic patients Archer[17] was unable to find in twenty patients with typical chronic infectious arthritis any evidence of a lowered tolerance

Clinicians have not as a rule found in the low carbohydrate diet the efficacy claimed for it This was the view expressed in the papers by Bauer, Bennett and Short [18] Archer[19] and more recently Bauer [1] Indeed, no harmful effects were seen from a diet unusually high in carbohydrate The last named author quotes the experience of Lackie and Wowen, who saw no ill effects in cases of extreme arthritis from a mixed diet containing 450 to 525 gm of carbohydrate, and of Dawson, who comparing the restricted diet with an unlimited carbohydrate intake, reports that patients always do better under optimal nutrition Emphasis is laid upon the difficulties to be overcome in the treatment of patients with rheumatoid arthritis whose nutrition has been impaired by a low carbohydrate diet Similar conclusions were reached by Archer[19] from his study of more than 2000 cases of nonspecific arthritis and by Hall and Myers,[20] who, after comparing the dietary habits of seventy five arthritic patients with those of patients without articular symptoms, were unable to find any direct relationship between diet and chronic arthritis It appears, then, that carbohydrate restriction or other dietary curtailment in chronic arthritis is useless and that the chief aim of dietary regulation *should be to maintain the patient in an optimal* state of nutrition

The skepticism which has just been expressed does not mean that the physician should neglect to prescribe a diet for the patient with rheumatoid arthritis Far from it Directions as to diet are advisable to insure better nutrition, and as evidence of the close attention to detail which every case of arthritis deserves Such instructions tell the patient that the physician is genuinely interested in his welfare This imbues him with the confidence necessary to the successful treatment of long continued chronic disease The dietary instructions should be in written form (never on a printed slip!) and should be designed to correct faulty habits as well as to insure adequate nutrition

For this purpose the food should be well balanced (See Chapter 11) The caloric intake should be sufficient to maintain nutritive equilibrium, except in cases of obesity or near obesity, when it should be appro

priately restricted The food should include adequate *protein* (100 gm more or less daily), largely in the form of meat, eggs and milk It should provide adequate minerals, particularly iron, phosphorus and calcium, and for this reason should contain an abundance of fruits and green *vegetables To insure a sufficient supply of calcium, at least two glasses* of milk daily should be taken

Vitamins in abundance should be provided The milk and green vegetables will probably supply sufficient amounts of vitamin A and *thiamine* Much discussion has centered around the low blood values for ascorbic acid found in rheumatoid arthritis and the possible relationship which lack of this vitamin bears to diseases of the joints Although there is probably no directly causative relationship, it seems reasonable to conclude from the figures for the ascorbic acid content of the blood which have been reported that special care should be taken to assure the patient of a liberal intake of this factor Vitamin C may be given in the form of orange juice or tomato juice, one or two glasses of each daily, or as pure ascorbic acid, 100 mg or more daily Massive doses of vitamin D in the form of a preparation known as ertron have been widely recommended Its use has proved of little value and has led, in many instances, to intoxication with vitamin D (hypervitaminosis D). Hench and his associates[21] believe that such therapy is still in the experimental stage and is not yet a rational treatment The administration of desoxycorticosterone acetate with ascorbic acid has been advised, but recent studies would indicate that this is of no specific value [22] A recent reviewer[23] pertinently writes "The use of proper medication for the relief of pain is warranted All other methods such as the use of vaccines fever, sulfur, vitamins (including activated vaporized sterol), bee venom, histamine, penicillin and sulfonamide compounds, roentgen radiation and induced jaundice are still in an experimental and unestablished stage, and the weight of evidence points to the belief that most of them are useless"

*The problem of diet is sometimes complicated* by the fact that the patient cannot take much roughage and therefore must limit his consumption of leafy vegetables For such a patient the smooth type of diet (see Irritable Colon) should be prescribed, every precaution being taken *to protect against vitamin deficiency To secure* an abundance of vitamins these should be taken in concentrated form, preferably as brewers' yeast, crude liver extract or in preparations of the B complex

As an example of the type of normal diet suitable in chronic arthritis, Bauer[1] suggested the following

**Table 123 Menu for a Patient with Rheumatoid Arthritis (Bauer)**

Breakfast
- Fresh fruit—average serving
- Orange or grapefruit juice—1 glass
- Eggs—2
- Bacon—3 slices
- Rye bread toast—1 slice
- Butter—2 squares
- Coffee with 40% cream

Dinner
- Clear soup or broth
- Meat or fish—average serving
- Vegetable—average serving
- Fruit or vegetable salad with mayonnaise
- Extra vegetable—average serving
- Milk or buttermilk—1 glass
- Rye bread—1 slice
- Butter—2 squares
- Fruit dessert

Supper
- Tomato juice—6 ounces
- Liver chicken or lamb chop—average serving
- Vegetable cooked—average serving
- Fresh vegetable as lettuce tomatoes celery etc.
- Rye bread—1 slice
- Milk or buttermilk—1 glass
- Fruit dessert

1 Sugar bread and other desserts would be allowed in this dietary if the patient were not overweight

2 In addition to the above we usually prescribe cod liver oil or one of the cod liver oil concentrates as well as some one of the vitamin B concentrate preparations

## DEGENERATIVE OR HYPERTROPHIC ARTHRITIS

Degenerative arthritis is a disease which accompanies advancing years It is not caused by infection metabolic disorder or endocrine dysfunction, but according to the consensus is the result of wear and tear of long continued trauma It is the arthritis of persons who are physiologically old

If, as is asked by Bauer,[1] hypertrophic arthritis expresses merely the changes in the joints which come from wear and tear, what role then, can diet play in its treatment? Only one by reducing the body weight it can lift a burden from the joints and thereby lessen wear and tear No other benefit can be expected

Reduction in weight, not only of the obese but also of those who are only a few pounds overweight, is a wise procedure in hypertrophic arthritis It should be judiciously done with due regard for the patient s need for vitamins minerals and proteins (see Chap 17) The patient whose weight is normal or subnormal should be subjected only to such dietary regulation as will best insure optimal nutrition

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# 26

## *Diseases of the Nervous System*

The integrity of the nervous system is profoundedly dependent upon the state of the animal's nutrition Minor grades of nutritive failure often lead to functional derangements, while more pronounced deficiencies, if long continued, may lead to widespread structural damage Examples of the former are seen in the irritability and restlessness which McCollum noted in rats fed on rations lacking in protein, in the 'neurasthenia' seen in pellagra, in the anorexia, with lack of intestinal muscle tone, seen in minor degrees of thiamine deficiency, and in the tingling in the fingers and the interference with the finer movements of coordination encountered in pernicious anemia In these instances complete recovery of function can be accomplished by restoration to the normal nutritive state Examples of structural damage are seen in the polyneuritis of fowls suffering from thiamine deficiency, in changes in the medullary sheath and axis cylinders of the peripheral nerves and posterior columns reported by Cowgill and his associates[1] in dogs fed on rations deficient in riboflavin, and in the changes which occur both in the spinal cord and in the peripheral nerves in such deficiency diseases as beriberi, pernicious anemia and pellagra Examples could be multiplied Since the functional changes of dietary deficiency are amenable to treatment and occur before structural damage is done, it is to these that the physician's attention should chiefly be directed As has aptly been said, heart disease is bad and cancer is worse, but the greatest tragedy that comes to man is the emotional depression, the dulling of the intellect and the loss of efficiency caused by nutritional failure

For the purpose of this book nervous diseases can be divided into three groups (1) those caused by the lack of one or more nutritive elements (2) those of other nature, which nonetheless can be influenced by improvement in the nutritive status and (3) those which are uninfluenced by diet

### NERVOUS DISORDERS DUE TO NUTRITIVE DEFICIENCY

This group of disorders is an ever widening one, and in it are now included many types of neural degeneration, with or without changes in the spinal cord which formerly were believed to be of other nature These disorders may appear as obscure features in the background, or they may dominate the clinical picture They include the nervous dis

orders sometimes associated with the following diseases, many of which are related

A neurasthenic syndrome
Pellagra pernicious anemia sprue
Polyneuropathy (beriberi), Wernicke s syndrome and nicotinic acid deficiency encephalopathy
The polyneuritis of pregnancy hunger edema and pernicious vomiting
Chronic colitis and chronic bacillary dysentery
The cachexia of senility cancer and tuberculosis

*Neurasthenia* is one of the earliest manifestations of nutritive deficiency I have been impressed by its frequency in preclinical pellagra and other forms of nutritional failure, and Williams and his associates[2] have described it as one of the early manifestations of induced thiamine deficiency The most outstanding features of this syndrome are easy exhaustion, anorexia, digestive disorders, a state of anxiety, and insomnia

The neural changes in pernicious anemia, pellagra and sprue have already been discussed Functional impairment, which may result merely in a tingling sensation in the fingers or toes and loss of vibratory sense occurs first If the physician is alert, these signs will provide a warning Treatment with vitamin $B_{12}$ or liver extract will stop the progress of the disease and restore functional integrity Subsequently, when structural damage is done it cannot be undone

Even in this last instance, however, too fatalistic an attitude should not be taken, for abeyance of function in a neuron may not always be due to structural damage it sometimes represents merely a reversible functional impairment Experience has demonstrated that in such cases energetic treatment with large doses of liver extract given parenterally will sometimes bring unexpectedly good results In pellagra, nicotinic acid thiamine and riboflavin should also be given

The polyneuropathies of thiamine deficiency, whether mild or severe, are, according to Jolliffe[3] always bilateral and symmetrical and characteristically involve first and predominantly the lower extremities These disorders, however, are seldom due to lack of thiamine alone other deficiencies also give color to the picture The same is true of *Wernicke s syndrome* of polyneuropathy, opthalmoplegia ataxia and mental cloudiness This disorder is often associated with chronic alcoholism and is possibly related to the nicotinic acid deficiency encephalopathy with its sucking and grasping reflexes changing cogwheel rigidity and progressive clouding of consciousness described by Jolliffe and his associates[4]

The *polyneuritis of pregnancy*, as was suggested earlier by Wechsler, has been reported by Strauss and McDonald[5] to be related to dietary deficiency, largely to lack of thiamine The same is apparently true, according to Williams and Spies[6] of the neuritis of colitis The last named authors are of the opinion that the neural changes seen in many forms of cachexia are also of this nature

*Treatment* of the disorders just mentioned was discussed in earlier chapters Three principles warrant emphasis

1 Dependence should be placed first and always upon a balanced

diet which supplies all nutritive essentials in liberal amounts Milk and milk products, eggs, liver and muscle meats, green vegetables, fruits, particularly citrus fruits, and enriched bread should all be included If the patient s digestive tract is seriously impaired, the vegetables should be given in puréed form

2 The deficiency seldom if ever occurs singly, and therapeutic efforts, therefore, should be broad If one member of the B complex, for example, is missing, other members also are probably missing

3 Vitamins may be given in pure crystalline form, but concentrates, notably those of the B complex, should also be included Among these last brewers' yeast is especially effective Equally effective and more certain in its action is a solution of liver extract given intramuscularly These products should be given in relatively large doses, say 50 gm or more of brewers' yeast, or 5 cc of liver extract each day

### NERVOUS DISORDERS OF OTHER NATURE WHICH CAN BE INFLUENCED BY DIET

Nervous disorders which are not due to nutritive deficiency but which are sometimes influenced by diet are the psychoses and psychoneuroses (including anorexia nervosa), migraine and epilepsy

Schizophrenia Patients with schizophrenia are being subjected today to shock treatment, and a fair degree of success is reported [7] The technic of this treatment does not fall within the scope of this book, but something should be said of the value of diet in alleviating the possible ill effects of shock produced by insulin and in preventing so called 'after shock" Waide and Hastings[8] devised the following schedule for use during the period of treatment

Morning group (time and Calories are approximate)

| | | |
|---|---|---|
| | 1 | No breakfast |
| 7 00 A M | 2 | Insulin given |
| 11 00 A M | 3 | Interruption of hypoglycemia with 50 cc of 25 per cent glucose intravenously followed within five minutes by |
| 11 05 A M | 4 | *Double tray (1600 C)* |
| 12 30 P M | 5 | Normal lunch (800 C) |
| 5 00 P M | 6 | Normal supper (1000 C) |
| 9 00 P M | 7 | Extra nourishment (400 C) |

Afternoon group (time and Calories are approximate)

| | | |
|---|---|---|
| 7 00 A M | 1 | Light breakfast (350 C) |
| | 2 | No lunch |
| 1 00 P M | 3 | Insulin given |
| 5 00 P M | 4 | Interruption of hypoglycemia with 50 cc of 25 per cent glucose intravenously followed within five minutes by |
| 5 00 P M | 5 | Double tray (1600 C) |
| 6 30 P M | 6 | Normal lunch (800 C) |
| 9 00 P M | 7 | Normal supper (1000 C) |
| 10 30 P M | 8 | Extra nourishment (400 C) |

In their experience this schedule gave satisfactory results except for two disadvantages it was difficult to induce the patient to take the 'double tray of 1600 Calories and the high caloric intake sometimes caused an undesirable gain in weight They still use this regimen for

underweight patients, but for others they have found the following schedule more suitable

| | | |
|---|---|---|
| | 1 | No breakfast |
| 7 00 A M | 2 | Insulin given |
| 11 00 A M | 3 | Interruption of hypoglycemia with 50 cc. of 25 per cent glucose intravenously followed within five minutes by |
| 11 05 A M | 4 | Cane sugar solution (to meet the insulin dosage requirements) plus a slice or two of bread and jelly (For dosages over 150 units of insulin the patient receives a normal breakfast in addition to 30 ounces of the sugar solution ) |
| 12 30 P M | 5 | Normal lunch |
| 5 00 P M | 6 | Normal supper |
| 9 00 P M | 7 | Extra nourishment |

Evidence was offered by Meduna and his associates[9] to show that schizophrenia is, in certain instances at least, related to a disturbance of carbohydrate metabolism These investigators tell of the presence of an anti insulin' factor in the blood of schizophrenics which acts antagonistically to normal carbohydrate metabolism, and they hazard the suggestion that this is one of the etiologic factors of the disease No effort has been made, however, to correct this anomaly by dietary means

**Psychoneuroses** The psychoneuroses are sometimes due to nutritive deficiency, few results in medicine are more dramatic than the manner in which a wildly delirious pellagrin will, sometimes within thirty six hours, become calm and rational after receiving nicotinic acid Disorders of this group can be corrected by treatment of the underlying cause

Patients with other psychoneuroses which are not related in their origin to nutritional failure can sometimes be greatly benefited by well considered dietary regulation A suggestion of this possibility is seen in the reported improvement in the mental functioning of rats after the administration of glutamic acid, and in the encouraging results achieved in human subjects Albert and his associates[10] gave glutamic acid orally (8 to 10 gm per day) to eight epileptics and in seven of *these saw raised levels of mental functioning This improvement lasted,* however, only as long as this amino acid was given No one would make bold to say that manic depressive insanity is the result of nutritional failure, yet I have seen remarkable improvement in the poise of a patient who for thirty years had been so handicapped, when her gross dietary faults were corrected and a balanced diet was adopted It is well therefore in all psychoneuroses to insist upon adequate food of the right kind Unexpected improvement may sometimes follow

**Anorexia Nervosa** Anorexia nervosa, amounting at times to actual repugnance toward food, is a form of psychoneurosis, occurring most often in young women, which is sometimes so persistent as actually to endanger life Ryle,[11] from a personal experience with fifty one cases in sixty one years of active practice, writes 'In common with other psychoneurotic disorders the incidence is higher in the upper and middle classes motive and opportunity and perpetuating causes are more frequent in homes where circumstances do not demand active physical occupation and where sensitive natures and solicitude flourish side by side' This author states that the onset is usually insidious and that

the salient features are poor appetite, loss of weight and amenorrhea Cobb[12] regards this as a serious disease and states that it has a relatively high mortality rate Notwithstanding the periods of improvement that sometimes accompany forced feedings, this author believes that unless the patient can be helped by means of psychotherapy to achieve a solu tion of the emotional difficulties the periods of starvation will continue and that ultimately commitment to a mental hospital will become necessary The disorder can be diagnosed by recognition of the psycho neurotic substratum and the exclusion of other diseases

Treatment consists chiefly in complete rest, physical and mental, psy chotherapy and dietary regulation Psychic influences predominate in the causation of this disorder, therefore psychotherapy, carefully applied with patience and great firmness, is often necessary to overcome it I agree with Ryle when he says that simple direct explanation separately to parents and patient is the first therapeutic essential

Berkman[13] regards the bringing about of a gradual distention of the stomach at meal time as an important part of treatment He carries out the treatment in the following manner A rough estimate of the patient's daily caloric intake prior to arrival at the clinic is made To this figure is added 300 Calories The patient is served a high protein high vitamin diet based on that number of Calories (usually from 1300 to 1500 Calories) and is asked to eat everything served to him or her For the first few days the patient may complain of distress and a sensa tion of fullness However, after several days these symptoms gradually become less After five or six days the caloric content of the diet is increased by another 300 Calories For the first two or three days dis comfort is again experienced however, the symptoms again become less This procedure is repeated until the caloric intake is approximately 3400 or 3600 Calories The patients at this stage of the treatment ex perience far less distress eating this diet than they experienced eating the initial diet based on 1300 to 1500 Calories Frequently, the distress becomes markedly decreased before the diet based on 3200 Calories has been reached In a number of instances the diet has been increased without difficulty to one based on 3800 Calories or more

The use of the stomach tube for forced feeding may be necessary for a time Occasionally the patient s nutritive state is improved by this procedure to such an extent that when it is discontinued he or she will begin to eat The basal metabolic rate of these patients is low, and thyroid substance is sometimes successfully used McCullagh and Tapper, however, regard hypometabolism as a compensatory and protective mechanism and are inclined to advise against thyroid medication

*Rest Cure* The rest cure devised by Weir Mitchell is occasionally suitable for psychoneurotic patients It involves three therapeutic fac tors (1) complete physical and mental relaxation, (2) psychotherapy, and (3) adequate nutrition Only the last of these need be discussed here

The dietary regulation in the rest cure has as its object not only the correction of nutritional deficiency, but also the disciplining and edu cating of the patient The first object requires that he be given not only

a well balanced diet which contains all nutritive essentials, but in many instances a sufficient excess to make up for previous chronic starvation For the attainment of the second objective, patience, persistence and firmness are often demanded The patient must be shown the folly of many of his dietary phobias, he must be required to eat the foods which are good for him, but which he possibly does not like, and he must be taught the type of diet best suited to the maintenance of health

It is as a rule best in the beginning to give nothing but milk, about 6 ounces of cold milk every two hours from 7 A M to 9 P M Milk should be insisted on in spite of all possible objections Before agreeing to its omission the physician must satisfy himself that the patient is actually sensitive to milk proteins or that for other good reasons the patient cannot take this valuable food, such patients are extremely rare, possibly one in a hundred The reason for thus insisting on milk are (1) that it is an excellent article of food which every patient should learn to take, (2) that its use for a time will rest the stomach and intestines, and (3) that for those who are afflicted with phobias and notions discipline in the very beginning is essential Patients with vascular hypertension and those with threatened myocardial disease are often materially benefited by the milk diet This should be continued for four to seven days at the end of which time other foods may be added This additional food may be permitted gradually, or—and I have found this to work well—it may without warning be given as a full, well balanced meal which the patient is told he must eat Usually he is by this time hungry and will take the full diet gladly The diet which follows should be distinctly individual and should depend on the patient's needs and in a measure on his tastes

For the purposes of dietary regulation, two types of psychoneurotic patients are recognized the thin, undernourished anemic person and the overfed, ruddy person, often with arteriosclerosis and arterial hypertension Patients of the first type require an abundance of good food and should as a rule be subjected to forced feeding Three full meals daily should be given, in which are included two helpings of meat and an abundance of fruits and green vegetables Milk with the meals and between meals and perhaps raw eggs after meals should be given Because of its blood building qualities, liver as well as muscle meats should be included Everything should be done to stimulate the appetite The food should be nicely prepared and appetizing and should be arranged on an attractive tray

The other type of patient should have a well balanced diet which meets but does not exceed his actual caloric needs Emphasis should not be laid on any one particular food Meat should not be excluded but should be permitted in moderation An abundance of green vegetables and fruits is desirable

Migraine Migraine has been the subject of a great deal of investigation but its cause is still obscure, heredity being the only causative factor of which there is any definite knowledge It is sometimes attributed to allergy In his comprehensive review Riley[14] discussed the various theories which have been offered The discovery of the effectiveness

of ergotamine tartrate in relieving the headache not only represents an important therapeutic achievement, but points the way to vascular studies which may throw light on the nature of the disease Cobb[15] quotes as an encouraging contribution to this subject the work of Graham and Wolf, who explain the attack of migraine on the basis of changes in the pulse pressure in the extracerebral vessels He also quotes the reports of Penfield and McNaughten, who tell of sensory fibers running from the trigeminal nerve to the dural sinus and of pain similar to migraine which was caused by traction on the veins that enter the sinus It would appear that migraine represents some form of vascular crisis and that, according to the susceptibilities of the patient, a great variety of factors are capable of precipitating the attack

No single dietary regimen is suitable in all cases of migraine Because nausea and vomiting are frequent accompaniment of the attack, the belief has become firmly fixed in the minds of many that some dietary fault is the responsible factor It is necessary to combat this error In spite of the prominent place which gastrointestinal disturbance occupies in the syndrome of migraine, it seldom bears any etiologic relationship to the disease If the patient is found to be allergic to any foods or to have dietary idiosyncrasies, the foods at fault should be excluded from the diet The attack may be precipitated by various dietary indiscretions, but in my experience allergy is seldom the cause

The patient should be advised against the many fads and forms of dietary restrictions which he may be tempted to try He should have a full, well balanced diet which provides all the essentials

**Epilepsy.** Epilepsy is a symptom It has no one cause, but is a manifestation of a variety of lesions of the central nervous system Heredity plays a part but probably only to the extent of providing the patient with nerve structures which are more sensitive than are those of other persons

This problem of epilepsy has been greatly clarified by the use of electroencephalography The seizure is accompanied by disturbances in the normal electric activity of the brain and can be regarded, therefore, as the outward manifestations of cerebral dysrhythmia'[16] It is possible to distinguish the different rhythms of the three types of seizure—petit mal grand mal and psychic variants

The *diet*, as Lennox[17] advises should be adequate, but need not be specified unless constipation or other disturbance of function is present In children this author advises a high fat low carbohydrate (ketogenic) diet especially for the petit mal He mentions limitation of fluids (the dehydration treatment), but regards it as difficult to execute and far less effective than the use of drugs

The *ketogenic diet* is seldom used today Its disadvantages are that it is unpalatable is difficult to arrange, is distinctly lacking in balance, and may lead to nutritional disorders

Treatment is begun with a period of fasting, usually for a week or until the seizures have stopped, during which period the patient is permitted only water, broths, specially prepared bran wafers without food value and a little orange juice Then the ketogenic diet is begun The

essential features of the diet are extremely small amount of carbohydrate (10 to 20 gm), about 1 gm of protein per kilogram of body weight and sufficient fat to meet full caloric requirements This gives the desired ratio of fat

After this diet has been continued for about three months if there are no further attacks the intake of carbohydrate may gradually be increased to about 50 gm daily and that of fat reduced accordingly Thereafter the daily allowance of carbohydrate and protein should be increased at the rate of about 5 gm each per month Talbot warns against rapid restoration of the allowance of carbohydrate

Because of the low carbohydrate allowance, no bread or other starchy foods may be taken only 5 per cent vegetables and small quantities of 10 per cent fruits may be included in the menu Spinach tomato lettuce, beet greens, cabbage, cucumber, rhubarb, lemon juice and orange juice are appropriate In order to minimize the destruction of vitamins a part of the vegetables should be eaten raw or cooked only a short time Fresh tomato may be eaten as a salad, or it may be baked in butter stewed or broiled and served with bacon Saccharin may be added to lemon juice or orange juice of which a small amount should be taken daily

**Table 124 Specimen Ketogenic Diets (Clap and Koehne[10])**

Number 1 Calories 2200

| | Amount (Gm) | Carbo-hydrate | Protein | Fat | Ca | P | Fe |
|---|---|---|---|---|---|---|---|
| Breakfast | | | | | | | |
| Orange | 40 | 5 1 | 0 3 | 0 2 | 0 018 | 0 008 | 0 00008 |
| Bacon | 30 | | 3 2 | 19 4 | 0 002 | 0 034 | 0 00048 |
| Egg | 100 | | 13 4 | 10 5 | 0 067 | 0 180 | 0 0030 |
| Butter | 20 | | 0 2 | 17 0 | | | |
| Cream | 60 | 1 5 | 1 3 | 24 0 | 0 052 | 0 040 | 0 0001 |
| Agar | | | | | | | |
| Bran wafers | | | | | | | |
| Lunch | | | | | | | |
| Chop A P | 60 | | 11 0 | 16 0 | 0 007 | 0 122 | 0 00169 |
| Cauliflower | 80 | 3 1 | 1 0 | 0 2 | 0 098 | 0 049 | 0 00048 |
| Butter | 30 | | 0 3 | 25 5 | | | |
| Pineapple mousse | | | | | | | |
| Cream | 80 | 2 4 | 1 8 | 32 0 | 0 069 | 0 054 | 0 00016 |
| Pineapple | 30 | 2 6 | 0 1 | 0 1 | 0 005 | 0 008 | 0 00015 |
| Supper | | | | | | | |
| Egg | 50 | | 6 7 | 5 3 | 0 034 | 0 090 | 0 00150 |
| Cheese | 25 | 0 1 | 7 2 | 9 0 | 0 233 | 0 170 | 0 00032 |
| Lettuce | 30 | 1 2 | 0 4 | 0 1 | 0 013 | 0 013 | 0 00021 |
| Tomato | 50 | 2 0 | 0 7 | 0 2 | 0 005 | 0 013 | 0 00020 |
| Mayonnaise | 20 | | | 16 0 | | | |
| Cream | 90 | 2 7 | 2 0 | 36 0 | 0 077 | 0 060 | 0 00018 |
| Butter | 10 | | 0 1 | 8 5 | | | |
| Agar | | | | | | | |
| Total | | 21 0 | 29 7 | 220 0 | 0 680 | 0 841 | 0 00855 |

Number 2 Calories 2800

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Breakfast | | | | | | | |
| Grapefruit | 30 | 2 6 | 0 1 | 0 1 | 0 006 | 0 006 | 0 00009 |
| Bacon | 30 | | 3 2 | 19 4 | 0 002 | 0 034 | 0 00048 |
| Egg | 100 | | 13 4 | 10 5 | 0 067 | 0 180 | 0 00300 |
| Butter | 15 | | 0 2 | 12 8 | | | |
| Cream | 90 | 2 7 | 2 0 | 36 0 | 0 077 | 0 060 | 0 00018 |
| Lunch | | | | | | | |
| Egg | 50 | | 6 7 | 5 3 | 0 034 | 0 090 | 0 00150 |
| Salad | | | | | | | |
| Lettuce | 20 | 0 8 | 0 3 | 0 1 | 0 009 | 0 008 | 0 00014 |
| Cabbage | 30 | 1 2 | 0 4 | 0 1 | 0 014 | 0 009 | 0 00033 |
| Celery | 30 | 1 2 | 0 4 | 0 1 | 0 023 | 0 011 | 0 00015 |
| Mayonnaise | 40 | | | 22 0 | | | |
| Butter | 25 | | 0 3 | 21 3 | | | |
| Cream | 40 | 1 2 | 0 9 | 10 0 | 0 034 | 0 027 | 0 00008 |
| Strawberries | 30 | 2 6 | 0 1 | 0 1 | 0 012 | 0 008 | 0 00024 |
| Cream | 100 | 2 0 | 2 2 | 40 0 | 0 086 | 0 067 | 0 00020 |
| Supper | | | | | | | |
| Chop, A P | 60 | | 11 0 | 16 0 | 0 007 | 0 122 | 0 00169 |
| Asparagus | 80 | 3 1 | 1 0 | 0 2 | 0 020 | 0 031 | 0 00030 |
| Butter | 25 | | 0 2 | 21 3 | | | |
| Cream | 50 | 1 5 | 1 1 | 20 0 | 0 042 | 0 034 | 0 00010 |
| Custard | | | | | | | |
| Egg | 50 | | 6 7 | 5 3 | 0 034 | 0 090 | 0 00150 |
| Cream | 60 | 1 8 | 1 3 | 24 0 | 0 052 | 0 040 | 0 00012 |
| Water | | | | | | | |
| Total | | 20 7 | 51 5 | 280 6 | 0 519 | 0 817 | 0 00810 |

Liver should constitute a part of the protein allowance, and cod liver oil, especially for children may also be added

Fats, of which obviously there must be a large amount, should be eaten in the form of cream, butter egg yolk, fatty meats and oil dressings In the higher ratios, it is a difficult matter to include sufficient fats in the diet, and Talbot[18] recommends that the patient take a "dose" of some suitable nutritive oil with each meal He states that this is pleasanter than mixing the oil with the food and that as between olive oil and cod liver oil the latter is to be preferred

Some attention should be given to the vitamin and mineral content of the food The butter and other fats eaten will carry an adequate amount of the fat soluble factors the water soluble vitamins and the minerals will as a rule be taken in sufficient amounts with the green vegetables With the higher fat ratios, however, the mineral intake may fall dangerously low, and Talbot recommends in such cases a daily dose of 0 3 gm of calcium

If the stools are bulky and gray and the urine fails to show constantly a reaction for diacetic acid, it is probable that the fat has failed of absorption Some change in the kind of food is then advisable If the patient eats sweets or otherwise exceeds his carbohydrate allowance, this can as a rule be immediately detected by the disappearance of diacetic acid from the urine

The menus given in Table 124 were prepared by Clap and Koehne[19] and have been selected from those used at the Presbyterian Hospital in New York and at the Mayo Clinic The suggestions for improving the palatability of the diet were written by the same authors

**Suggestions for Improving the Palatability of the Diet** (Clap and Koehne[19])

1 *Use 40 per cent cream rather than 10 or 20* This may be used in coffee tea cocoa made from cocoa shells or as a beverage with water and saccharin added to it for palatability A frozen mo isse dessert contains large amounts of cream and is very palatable Other desserts may have whipped cream and walnuts added to them Vegetables may be served with cream soups may be made from concentrated vegetable juices and cream and cream may be used in desserts such as custards using saccharin to sweeten Cream cheese and American cheese are desirable for their mineral content as well as fat

2 *Use butter in large amounts* Butter may be added to clear broths meats vegetables and desserts Peanut butter is well liked and cheese creamed with butter In fact to d [illegible]

and sardines Some steaks or chops may be used with butter sauce added

6 *Use bacon fat* or butter for scrambling eggs

7 *Thrice cooked vegetables* may be used as fillers but these cannot be depended upon for their water soluble vitamin content or for all their natural mineral salts

8 *D Zerta—diabetic gelatin or agar jelly* served with whipped cream will lend variety to the menu although the food value is negligible

**Recipe for Bran Wafers** (Talbot[18])

| | |
|---|---|
| Washed bran | 3 cups |
| Powdered India gum | 3 tablespoonfuls |
| Cinnamon | 2 tablespoonfuls |
| *Saccharin (dissolved in water)* | *1 gm* |

Mix the dry ingredients together then add enough hot water to make a paste that can be spread on a baking sheet Cut this in squares and dry in a moderate oven for two or three hours If an attempt is made to bake these more quickly they will burn before they are crisp

Tabes Dorsalis The type of diet suited to the patient with this disease depends entirely on the extent of his disability As a rule a simple, well balanced wholesome diet such as has been advised for the normal person is suitable In the more advanced stages it is often advisable to give the patient frequent feedings (five meals daily) and to restrict him to the simpler more easily digested foods In restricting the food however, care should be taken to see that he receives enough nourishment and that all essential elements are included The constipation which frequently accompanies this disease can in a measure be prevented by an abundance of vegetables and fruits It is not necessary to interdict coffee, tea and alcohol altogether, but they should be taken sparingly It is sometimes necessary to combat phobias which the patient may have concerning the harmful effect of certain articles of diet—for instance, meat

What has been said of tabes dorsalis applies also to other manifestations of syphilis of the spinal cord to Friedreich s ataxia and to acute and chronic myelitis The necessity for preserving the patient s strength

applies with the same force in these diseases as in other forms of acute and chronic illness

Multiple sclerosis has been attributed to vitamin deficiency, but the evidence presented has been discarded

Parkinson's syndrome has been treated with pyridoxine Jolliffe reports a measure of success, but many failures also have been reported

**Chronic Progressive Bulbar Palsy** This condition requires special comment because of the necessity for permitting the affected muscles, particularly those of deglutition, as much rest as possible, while at the same time the patient's nutrition is preserved at the highest possible level Difficulty in swallowing intensifies the problem Milk in any form, raw or soft boiled eggs, cereals with cream and other highly nutritious foods in a liquid or semisolid state should be given Meat, when permitted should be thoroughly ground and preferably given in the form of a purée Carbohydrates should be largely in the form of gruels, since these are swallowed more easily than dry bread Some patients swallow semisolid food better than liquids Later in the illness when the patient can no longer swallow, he should be nourished through a stomach tube, but this method of feeding should be postponed as long as possible A little coffee once daily may be permitted but as a rule caffeine containing drinks and alcohol are undesirable

**Disorders of the Brain** Such disorders as cerebral hemorrhage, thrombosis tumor, abscess and syphilis are not influenced by any particular type of diet The extent of the patient s debility should determine the kind and quantity of food and the frequency of the feedings

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# 27

## *Endocrine Disorders*

Numerous examples could be cited of the close relationship of endocrine function and nutritive state To mention but a few Hyperthyroidism is characterized by an increased caloric requirement which is often reflected in appreciable weight loss, as well as clinical evidence of thiamine lack In experimental animals, induced hyperthyroidism may lead to a more rapid development of deficiency syndromes such as that of vitamin $B_{12}$ deficiency As was noted in Chapter 5, there is much evidence for an essential role of panthothenic acid in the functioning of the adrenal glands Folic acid and riboflavin both participate in some manner in the metabolism of the sex hormones Widespread experience with starvation which grew out of World War II has revealed that gynecomastia is a frequent consequence of prolonged severe undernutrition A legion of such examples could be cited Despite this evidence however, there are few clear indications for *specific* dietary therapy which is peculiarly beneficial in endocrine disorders Two exceptions to this are goiter and iodine and Addison's disease and sodium chloride On the other hand the adequate therapy of all metabolic disorders includes the provision of an abundant diet of the type discussed in Chapter 11 with specific modifications to insure the correction of incidental nutritive faults

### SIMPLE GOITER

Iodine is an essential component of thyroxine, the active principle of the thyroid gland If the gland does not receive a sufficient supply of this element it is unable to manufacture its chief product, and it hypertrophies in the effort to meet the physiologic demands made on it This type of simple goiter is characterized by Marine[1] as 'a compensatory or work hyperplasia immediately dependent on a relative or absolute deficiency of iodine ' This deficiency may be absolute, which would explain the greater incidence of goiter in certain regions, or it may be relative in which case the supply of iodine may be normal, but its utilization is impaired The presence of goitrogenic substances in certain foods notably cabbage has now been crystallized by the isolation of *l* 5 vinyl 2 thio-oxazolidone, an antithyroid compound, from the seed of

the turnip, cabbage, kale, and rape.[2] The importance of this as a r anism for the production of goiter in man is poorly understood.[2a]

Simple goiter often begins about the age of puberty; other pe of predisposition are fetal life, pregnancy and the menopause. It is common among females than among males. Adolescent girls in "g areas" are particularly prone to this disorder. It may appear anyw but it is endemic in what is known as the "goiter region." In N America these regions embrace the Pacific Northwest and the bas the Great Lakes and the St. Lawrence River. The geographic dist tion of goiter is related to geologic formation and to the amou iodine in the water and soil. This disease is frequent wherever the v and vegetables are poor in this element.

Simple goiter can be prevented and often cured by the administr of iodine. Marine and Kimball,[3] for the schools of Akron, Ohio, w they found a prevalence of this disorder, proposed that each pup the lower grades be given daily for ten days 0.2 gm. of sodium ic and that those of the upper grades be given double this amount, procedure to be followed twice each year, in May and in Decen Marine later regarded this amount as excessive, for the normal thy gland can store only about 25 mg. of iodine, and the yearly utiliza of this element by the organism probably does not exceed 50 mg. F pregnant or lactating woman living in a "goiter district" should weekly 10 mg. of iodine. This element is equally effective in all forms in which it can be administered.

A word of warning should be given. Iodine in the treatment of orders of the thyroid gland can become a two-edged sword. It is of g value in the prevention of simple goiter, and in the minute doses adv it can do no harm; but the indiscriminate and continued administra of large doses of iodine may induce hyperthyroidism if the glan adenomatous. Reference should be made to two authoritative art published as reports of the Council on Food and Nutrition of American Medical Association: that on the part played by iodine nutrition[4] and that on the use of iodized salt in the prophylaxi endemic goiter.[5]

## EXOPHTHALMIC GOITER

This type of goiter is accompanied by such a rapid metabolic that, in order to prevent the destruction of his own tissues, the pat must be given an amount of food which under other circumstances wo be regarded as excessive. This is notably true of Calories and thiam Cowgill has shown that the thiamine requirement is greatly increa The diet should be a well-balanced one, such as any normal pe should eat, but the amount of food eaten should be increased in cordance with the elevation of the metabolic rate. A patient wh metabolic rate is 150 per cent of the normal rate should increase caloric intake 50 per cent or more. Boothby[6] believes that to meet patient's nutritive needs 75 per cent or more should be added to basal metabolic requirement, and Du Bois,[7] in considering the calc tions of Sturgis, reached a similar figure, 84 per cent.

The effort should be to preserve nitrogen equilibrium, and to this end the protein quota of the diet should be emphasized. In his study of the self-elected diets of patients with toxic goiter Jones[8] observed a uniform tendency toward the selection of a low-protein diet. Persistence of this preference after operation, when permitted, accounts, he believes, for many unfavorable postoperative results, notably fatigue, susceptibility to cold and sometimes to actual recurrence of the disease. Patients with exophthalmic goiter should, therefore, eat an abundance of good protein, in which is included a fairly liberal quantity of meat.

The disturbance in carbohydrate metabolism that occurs in this disease is due, according to Althausen,[9] not only to increased absorption, but also to increased oxidation of dextrose in the tissues; this finally leads to depletion of glycogen stores. Patients with this disease should, therefore, have frequent feedings and receive diets abundant in carbohydrates. There has been some suggestion of a lowered fat tolerance in this disease, but Hepler explains this upon the assumption that both the sugar and fat content of the blood are established and maintained at a higher level in order to sustain adequately the increased metabolism.

The diet should be abundant and should provide in liberal amounts all known essentials, especially vitamins A and C and those of the B complex. For this purpose milk, fruits and green vegetables should be generously provided. Vomiting and diarrhea may become distressing, in which case the diet should be restricted to the simplest foods, such as milk and cereals. Care should be taken, however, that such restriction is not carried too far.

Patients with hyperthyroidism can be much more satisfactorily nourished if at rest in bed. In severe hyperthyroidism, rest is essential. The type of treatment outlined for the rest cure of nervous patients, with full emphasis on the personality of the physician and of the nurse and its influence on the patient's morale, is appropriate here also. The influence of iodine in exophthalmic goiter is well known.

## ADDISON'S DISEASE

This disease is often accompanied by a deficiency of gastric juice which demands not only the administration of hydrochloric acid, but also some care in the choice of food. Diarrhea may become an exceedingly distressing symptom; I have known a patient with Addison's disease to die during a gastrointestinal upset which followed gross dietary indiscretions. For this reason it is advisable that the food be limited to such simple articles as milk, cereals with cream, soft-boiled or poached eggs, toast with butter and tender meats, and any of the simpler desserts, such as rice or tapioca pudding. Vitamins, particularly vitamin C, should be provided in liberal amounts. The latter may be given in the form of orange juice, but pure ascorbic acid (300 or 400 mg. daily) should also be given.

Sodium chloride decreases the need for the hormone and therefore should be added to the food in liberal amounts. In addition, 5 to 10 gm. daily should be given in the form of compressed tablets. Patients who are receiving desoxycorticosterone acetate, however, do not exper-

ience the same electrolyte disturbance as untreated persons and have not the same pressing need for sodium chloride.[10] Nor is the avoidance of foods high in potassium, as formerly recommended, necessary in such cases.

The great prostration which accompanies Addison's disease and also other vague states of weakness which may be related to this disease can to a small extent be combated by a highly nutritious, wholesome diet In her paper on diet in this disease Hesser[11] recommends frequent feedings with a balanced diet high in readily available carbohydrate (7 to 8 gm per kilogram). When vomiting or diarrhea becomes severe, it may be necessary to withhold all oral feeding for a time.

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# 28

## *Diseases of the Skin*

The patient with a disease of the skin expects to be given a diet He needs it, but not always for the reason he has in mind Dietary regulation accomplishes good in the treatment of cutaneous diseases, not so frequently by eliminating certain foods as by insuring an adequate intake of nutritive essentials, for it is the lack of food rather than its harmful effect that is the more frequent cause of cutaneous diseases

In support of this statement abundant evidence has been provided by animal experiments Animal breeders have long known that faulty nutrition will influence unfavorably the texture of an animal's skin and the fineness of its coat Witness, too, the typical dermatitis which occurs in rats as the result of riboflavin deficiency and the special type of dermatosis which occurs in these animals in the absence of pyridoxine Moncorps[1] has written of the seborrheic changes seen in the skin of rats suffering from a deficiency of pyridoxine and the correction of this and similar disorders in man by the administration of foods rich in this factor

Many diseases of the skin have been attributed, with varying weight of evidence, to vitamin deficiency The most typical of the dermatoses due to lack of *vitamin A* is the eruption described among the Chinese by Frazier and Hu[2] Characteristic papules appear around the hair follicles on the extensor surfaces of both the upper and the lower extremities, on the shoulders and on the lower part of the abdomen (see p 252) This eruption, however, occurs only in conditions of extreme avitaminosis Less characteristic but frequently encountered in the United States are the dermatoses of like causation but of milder degree described by Youmans and Corlette[3] and more recently by Savitt and Obermayer[3]

Other disorders said to be benefited by vitamin A therapy[4] are acne vulgaris and acneform eruptions with many horny dry plugs, alopecia circumscripta, brittle nails, calluses and corns, Darier's disease, excessively dry skin, ichthyosis, keratosis pilaris, lichen chronicus simplex, nummular eczema, pityriasis rubra pilaris, and skin lesions of the Plummer Vinson Sjogren syndrome Those disorders said to be benefited by the administration of *vitamin B* factors are acanthosis nigricans, acne vulgaris canites, chronic urticaria, herpes zoster, infantile eczema, insect bites (preventing reaction), lichen planus, parapsoriasis, photosensitivity, Plummer Vincent syndrome, pruritis (from different causes), psoriasis,

Ritter's disease, seborrheic dermatoses, vitiligo and leukodermas and vulvar dermatoses

Those diseases of the skin believed to be benefited by the administration of *vitamin C* are atopic dermatoses, chronic urticaria, hemorrhagic disease other than scurvy, hyperpigmentations of all kinds, *pruritis*, psoriasis, Plummer Vinson syndrome, torpid ulcers, varicose eczemas, and herpes zoster The validity of many of these claims, perhaps of most of them, *is open to question*

That the claims just listed cannot be accepted is seen in the painstaking work of Callaway, Milam and Noojin,[5] who studied the nutritive status of 350 unselected dermatology patients at Duke University at Durham, North Carolina These persons were given a comprehensive nutritional survey, and it was found that their status in this respect was typical of the usual findings in field nutritional surveys in North Carolina It was concluded that nutritional status was not a factor in the precipitation of the dermatologic diseases of the patients studied

Of the directly harmful effect of food in the production of diseases of the skin, little is definitely known True, allergy sometimes appears *to cause urticaria, angioneurotic edema* and *erythema and possibly other* disorders, but of the frequency with which it is a responsible factor, it is difficult to speak The influence of emotional factors is receiving increasing recognition [5a] They often appear to play a dominating role It is unfortunate that the skin tests commonly used are unreliable Elimination tests carried out according to the instructions of Rowe are of much greater value For further information the reader is referred to the section on allergy (p 355)

The intake of protein is sometimes limited in the treatment of cutaneous diseases, perhaps because eczema is fairly frequent in gout, but the harmful effects of this foodstuff have never been clearly demonstrated Since an adequate intake of protein is essential to vigor and well being and since its lack has been found to impair the smoothness of the coat of experimental animals, its restriction should be undertaken only with extreme caution

It is not so easy to dispose of the question of carbohydrate restriction which has long been advocated in the treatment of infantile eczema and acne, except to say that in the latter disease doubt has been thrown upon the efficacy of such restriction This subject will be discussed presently

Fatty foods in excessive amounts apparently have an unfavorable effect in certain cutaneous diseases, notably rosacea Probably, however, this can be attributed to the impairment of the digestive and absorptive powers that comes with the eating of rich foods as much as to the fat itself It is interesting, on the other hand, to recall the work of Burr,[6] Evans[7] and others showing that the absence of certain fatty acids from the ration of experimental animals causes a characteristic dermatitis, but it is only fair to add that this cannot be applied directly to the human subject [8] Reasonable restriction of fat in cases of disease of the skin *is proper*

The relation of nutrition to cutaneous diseases was thoroughly discussed in 1930 by Urbach,[9] whose views still pertinent, may be sum

marized as follows There are no special forms of diet effective in special diseases for instance, an eczema diet', such diets do not exist Nevertheless, dietary regulation in the treatment of cutaneous diseases may be effective in four directions (a) causative, as in the treatment of the underlying disease, notably in the dermatoses of such metabolic disorders as diabetes or gout, (b) eliminative, as in the withdrawal of the offending food from the diet in allergic urticaria and in the xanthosis of carotenemia, (c) regulatory, as in the effort to influence the chemistry of the skin, examples of which are the use of the salt poor diet in certain eczemas and of the Gerson Hermannsdorfer diet in the treatment of lupus vulgaris, and (d) supporting, as the improvement of the patient s general nutritive state through the correction of undernutrition, the re duction of obesity or the treatment of pellagra

When the physician reviews what has been written concerning the relationship of diet to diseases of the skin, he feels greatly at sea Only the following conclusions seem warranted (1) Allergy sometimes mani fests itself in the skin (2) Other forms of sensitiveness to food occas ionally lead to cutaneous diseases, but no one food seems to predominate in this respect and there is no constancy as to the type of disorder pro duced (3) In view of the frequency with which nutritive deficiency is known to cause dermatoses in experimental animals it would appear that a major object in the treatment of cutaneous diseases should be to nourish the patient adequately He should have an abundance of nutritive essentials

Comments regarding the treatment of a few of the commoner diseases of the skin are perhaps pertinent

**Eczema** Eczema can be regarded as the manifestation of a latent dermal susceptibility It may be produced by the widest variety of causes both internal and external Allergy is said to be a frequent cause and is believed by Coca[10] to be the expression of a familial tendency Other forms of food idiosyncrasy have also been incriminated Many derma tologists attribute the eczema of infants to carbohydrate intolerance, and others to protein sensitization The inability to assimilate fat has also been regarded as a cause When the mass of clinical evidence is reviewed, much of which is contradictory, it seems fair to say that no one food or group of foods is the cause of eczema Nervous factors often play a dominating role, and it is pertinent to suggest that in the use of elimination diets and other methods for the detection of food sensitive ness care should be taken not to deprive the patient of necessary food

**Acne Vulgaris** Acne vulgaris has long been thought to be due in part to an intolerance of carbohydrates but recent studies throw doubt upon that assumption Crawford and Swartz[11] gave a high carbohydrate diet, with intravenous injections of dextrose to ten patients who had suffered from six months to ten years with severe acne, predominantly pustular, and saw distinct improvement in five of these Two patients showed questionable improvement, and three were unchanged From this ex periment one would doubt the assumption that patients with acne have an intolerance for carbohydrate Indeed, some may show actual improve ment with a high carbohydrate diet

In the dietary treatment of this disease, wholesome habits should be inculcated Gross violations of hygiene, particularly irregularity in the time of eating, should be avoided The diet should consist of simple foods, among which should be included milk, eggs, tender meats, liver, fruits, green vegetables and cereals with cream Fatty foods should be avoided Acne vulgaris and the senile keratoses are reported to be definitely benefited by vitamin A therapy[3]

Rosacea This disorder is accompanied by an abnormal flushing of the face, which is dependent in turn on vasomotor instability Alcohol will produce it, and it is possible that hot drinks, particularly tea and coffee, will also Clinical experience indicates that this disorder may come also from gastrointestinal disturbances, but not necessarily from any particular food Rulison[12] reviewed the voluminous literature dealing with the relation of gastrointestinal disturbances to rosacea and studied fifty cases He reports that two thirds of his patients were found to have a group of functional abnormalities occurring with sufficient uniformity to suggest that they form an essential part of the disease He lists these abnormalities as follows a neurotic tendency, subnormal weight, low blood pressure, poor muscle tone, faulty posture visceroptosis, chronic constipation, spasticity of the large bowel and gastric subacidity Against such an assumption of relationship it can be argued that this association of abnormalities is also found in a host of patients who do not suffer from rosacea, but who have the greatest variety of other complaints Such gastrointestinal disturbances as are known to be present should be corrected Highly seasoned foods may so upset the stomach as to lead reflexly to circulatory disturbance in the skin and the same may be said of fried foods, rich desserts and condiments The diet suitable for patients with this disorder, then is obviously a simple one which includes no fried or greasy foods, no condiments or highly seasoned dishes and no tea, coffee or other hot drinks It should consist largely of milk cereals with cream, eggs and other easily digested, nutritious foods and should provide an abundance of vitamins

Erythema Erythema multiforme is possibly due to several different causes Some of the so called erythemas represent a manifestation of allergy, others possibly result from toxins generated in the intestinal tract, and still others are due to unknown causes and physical agents No particular type of food beyond the normal rational diet is demanded When the experience of the patient indicates with reasonable certainty that a particular food—shellfish for instance—produces erythema then that food should be eliminated from the menu The danger here is that imagination may get the best of both patient and physician and lead to unnecessary elimination of many valuable foods

*Dermatitis* Dermatitis is merely an inflammation of the skin which can be due to the widest variety of causes, internal or external No single dietary regimen is invariably suitable From a nutritional standpoint the only necessity is to be sure that the patient does not have diabetes and that his diet is adequate Vitamin $B_{12}$ is reported to be beneficial in the treatment of seborrheic dermatitis[12a] and nicotinic acid is said

to be helpful in the treatment of dermatitis herpetiformis. Vilter has observed seborrheic lesions in vitamin $B_6$ deficiency in man

Psoriasis. The cause of this disease is unknown It is futile, therefore, to discuss its treatment by diet except to say that no known dietary regimen is effective The restriction of protein and other dietary limitations sometimes imposed have not been found to be of value

Tuberculous skin lesions, notably lupus vulgaris, are reported to have been benefited to a degree by the administration of calciferol (vitamin $D_2$).[13]

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# 29

## *Nutrition in Surgery*

CHARLES C LUND, M D *

Until recently the state of nutrition of the patient before and after injury was of slight interest to the surgeon So little was known about effective nutritional therapy that surgeons paid attention only to the most elementary features of diets The importance of making certain that the patient had an empty stomach before operations, and had food presented to him as soon as reasonable after operation, has, of course, been well understood for a long time Also, it was known that excessively fat or excessively depleted patients did not withstand surgery well

During recent years many scientists have contributed an understanding of many of the important relations between nutrition and recovery from injury. In addition, a large number of particularly effective nutritional "tools" have become available to the surgeon

The most important concepts for the surgeon are three in number First, a small percentage of patients come to him who, in addition to or because of their surgical conditions, or for both reasons, are badly depleted in protein, various vitamins, and minerals Second, a great many other patients come to him who are depleted in the same substances to a lesser degree, but nevertheless, a degree that may lead to an adverse result of operation Third, an immediate result of injury, which includes such diverse conditions as acute illness, anesthesia, poisoning, and surgical operations, is a further depletion of these substances that is quantitatively related to the severity of the injury

These concepts indicate why a knowledge of certain aspects of nutrition may be considered to be even more important to the surgeon than to the internist, because the internist seldom has to carry out a form of treatment that contributes additional injury to the already depleted patient

* [illegible] Department of [illegible] is based [illegible] Medical [illegible] Uni
versity

The data on which this chap[illegible] he devoted aid of my former associates Drs F H L Taylor and Stanley M Levenson and many others

Still further, the surgeon must realize that nutrition is of greater importance in the repair of wounds than in the recovery from illness that does not include any cellular repair When the amounts of available protein, vitamins, and minerals are decreased beyond certain points, cells can neither divide nor produce intercellular substance Therefore, repair cannot take place Even lesser degrees of deficiencies cause serious delays in recovery and healing

### CONCEPT OF NUTRITIONAL BALANCE

Although nutritional balance has already been fully presented, it must be called to the attention of surgeons that this concept is of particular importance to them because the correction of nutritional deficiencies does not commence until the intake of the particular elements that are deficient has reached a level higher than that of their utilization and wastage By intake is meant, not ingestion into the stomach but absorption into the blood

**Protein** That protein deficiency interferes with wound healing in animals was first pointed out in 1918 [1] That severe protein deficiency is commonly found in certain surgical patients such as those with gastrointestinal diseases was shown in 1933 [2] That this deficiency in human patients is related to poor wound healing local wound edema, distention, and vomiting was shown in 1938 [3] Just prior to this time Cuthbertson[4] demonstrated the great amounts of nitrogen that are excreted in the urine after major fractures and showed that this nitrogen comes from broken down protein and is directly associated with the wasting in muscle size and strength Since then, others[5 6 7] have found excessive excretion of nitrogen in the urine to be associated with severe acute illness injury, or surgical operation It is particularly striking under such conditions as major infected fractures traumatic paraplegia, and major burns because in these cases the causes of excess excretion continue for a long time

Besides the nitrogen losses in the urine there may be other losses of great magnitude Some of these are the loss of plasma and pus from the surface of burns the loss of blood, serum or pus from any wound, losses of blood or pus into the gastrointestinal, pulmonary, and other tracts Few patients with external protein losses have been the subject of really complete metabolic studies but Levenson and his co workers[8] have calculated such losses in the case of burns and Hirschfeld and his associates[9] have actually measured them That such losses are considerable may be seen from Figure 14

It should be noted that Figure 14 indicates that the nitrogen intake began to exceed the output in the urine during the fifth week The patient s body weight, however, continued to fall until the twelfth week, when the intake began to average three times the losses in the urine At this time he had lost 60 pounds Part of this loss was from fat stores and part from muscle and other protein If half of the loss was from protein, it represents a daily loss of about 5 gm of nitrogen in the form of pus This amount equals 50 per cent of the nitrogen output in the urine which averaged 10 gm per day Hirschfeld actually measured the

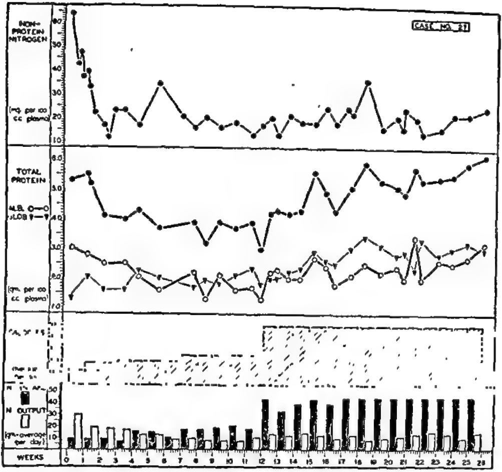


Fig. 14. The caloric intake data were averaged after the twelfth week and nitrogen after the seventeenth week. (Levenson, S. M., Davidson, C. S., Lund, C. C., and Taylor, F. H. L.: The Nutrition of Patients with Thermal Burns. Surg, Gynec. & Obst, Vol. 80.)

output and found it to amount to 25 per cent of the urine output in one of his cases.

*Carbohydrate and Fat.* Carbohydrate and fat are as important to the surgical patient as they are to the medical patient. They furnish Calories, and the food containing them furnishes vitamins and minerals. Surgeons, however, do not always realize how many Calories some of their patients need in order to furnish adequate Calories, and, therefore, to prevent the use of body fat and protein to furnish them. Increased basal metabolic rate and, therefore, increased need of Calories is seen in many surgical conditions, especially in hyperthyroidism and in all conditions in which fever is present. In extreme cases, bed patients may need 5000 Calories per day. In general the sick patient can digest a diet with a higher caloric value if the food contains a preponderance of protein and carbohydrate than if it contains a large proportion of fat. Therefore, a diet high in fat will seldom be practical for any surgical patient when there is a nutritional problem. Such a patient can also tolerate and utilize a greater intake of carbohydrate when the supply of protein and vitamins is adequate than when it is not.

*Vitamins.* Until recently data concerning the quantitative needs for vitamins in illness have been entirely lacking, although the National

Research Council standards for amounts of vitamins for the maintenance of good health have been generally accepted At present, assay methods have been perfected so that a rough approximation has been made of the needs for thiamine, riboflavin and niacin, and a rather close approximation of the needs for ascorbic acid in patients with severe burns[10] and in those with severe surgical shock[11] due to other injuries

In severe injury or illness there is a large increase in utilization or destruction of vitamins within the body These losses may take place in the patient who is already low in vitamins at the time of injury, and, because of low reserves, serious deficiencies occur rapidly Increased excretion of vitamins in recognizable forms in the urine or elsewhere has not been determined to result from injury or illness unless amounts have been given in treatment that are larger than those used, destroyed, and stored in the body Immediately after burns or injury such doses as 1 to 2 gm of ascorbic acid, 12 mg each of thiamine and riboflavin, and 200 mg of niacin have been used destroyed, or stored for several days

Minerals Probably all minerals in the body are affected by injury During a period of excessive nitrogen loss there is usually an associated loss of potassium of similar degree in the urine This loss is due in large part to the fact that cells containing smaller amounts of protein can only contain smaller amounts of potassium Sodium and chloride excretion in the urine ceases promptly after injury because large quantities of sodium and chloride are lost from the blood plasma into the injured area in the forms of edema fluid and may be lost from the body entirely through hemorrhage or through discharges from the skin, intestines or wounds, thus creating a deficit of these ions in the plasma Acute sodium chloride deficiency may also follow vomiting or diarrhea Iron may be lost with blood, and iron deficiency anemia will occur promptly in patients who have marked loss of blood Calcium metabolism in surgery is of special importance in the healing of fractures and in the rare disease hyperparathyroidism At times it may be necessary to pay special attention to the calcium intake in connection with the healing of fractures

## EVALUATION OF NUTRITIONAL STATUS OF THE SURGICAL PATIENT

The nutritional status of the surgical patient must in most instances be estimated rather than determined because of widespread lack of facilities for making the necessary laboratory determinations Under many conditions the nutritional needs however, may be estimated closely from available data

**Evaluation of Protein Needs** Plasma or serum protein determinations are of value as showing the state of the proteins in the blood at the time of the test But patients who have severe protein deficiencies in the body as a result of past wasting may, if in balance at the time of the test have normal or nearly normal values in the blood Also patients who are losing nitrogen rapidly may have low blood figures while they still have considerable amounts of tissue protein remaining in their muscles and elsewhere Therefore these determinations can only give

part of the information needed for a true evaluation of the state of protein nutrition of the patient Also, the methods of determination in the plasma based on specific gravity give results so variable that interpretations of them must be made cautiously Separate albumin and globulin determinations made by the Kjeldahl method are much more accurate

Also important in determining whether tissue proteins are depleted are measurements of the patient s weight and changes in the weight. In using such data in the very sick patient, however, one must always be on guard not to be misled by changes in weight due to retention or excretion of fluids Most patients who have lost weight rapidly, as well as most of those who are greatly underweight, are suffering from protein deficiencies of moderate to severe degrees

Elman[7] has studied and recorded the large weight losses following standard surgical operations and Hirschfield and associates[9] and Levenson and co workers[8], as well as others, have studied such losses in cases of burns Severe losses may be expected in all severe diseases Other surgical diseases in which severe losses are usually seen are traumatic paraplegia, major fractures and ulcerative colitis and other infections that do not respond promptly to chemotherapy

**Evaluation of Vitamin Needs** Available tests for the routine determination of vitamin levels are limited to prothrombin time for vitamin K deficiency, serum or plasma ascorbic acid levels and phosphatase calcium and phosphorus for appraisal of vitamin D Therefore, in clinical work patients must be guarded against harmful deficiences without the help of such tests A dietary history can be of enormous value in estimating the possibility of deficiencies The ordinary clinical manifestations of scurvy, pellagra beriberi riboflavin deficiency, and vitamin A deficiency must be carefully looked for, but will seldom be discovered Their absence is no indication that the patient needs none of these vitamins If there is any doubt whether or not the patient was deficient in these vitamins before his illness or if his illness is severe he should be given adequate supplements promptly for reasons that will appear later

**Evaluation of Mineral Needs** Patients who have had much vomiting or diarrhea or other losses of body fluids should be watched for signs of chloride deficiency and should have frequent blood chloride determinations made Patients with kidney damage or with protein deficiency should be watched and tested for hyperchloremia

Patients who have had no oral or tube feeding for more than five days may show signs of potassium deficiency, especially extreme muscular weakness unless potassium as well as sodium is given intravenously At least 10 milliequivalents of potassium chloride should be given daily to prevent this In acute situations 120 to 160 milliequivalents may be given in twenty four hours

**Preoperative Malnutrition** The recognition of nutritional deficiencies in nonacute surgical patients is of especial importance for the provision of adequate preoperative care The physician must be alert to conditioned deficiencies produced by certain chronic processes Prominent among these is iron deficiency anemia (hypochromic microcytic), which

is frequently encountered in patients with chronic blood loss due to peptic ulcer hemorrhoids menorrhagia or malignancies of the gastro intestinal tract Treatment of such patients with iron (0 3 gm of ferrous sulfate three times a day by mouth) *for a month or so prior to admis* sion to the hospital for operation will often reduce the necessity for transfusions at operation and provide a patient who is better prepared for the operation

Pernicious anemia and other macrocytic anemias must not be mis taken for iron deficiency—any anemia encountered in a surgical patient should be classified to permit the establishment of rational therapy The presence of a macrocytic anemia should remind the physician of the asso ciation between gastric malignancy and pernicious anemia Patients with known pernicious anemia should continue to receive their maintenance therapy of liver extract or vitamin $B_{12}$ throughout periods of surgical illness

Chronic biliary obstruction and long standing steatorrhea may pro duce a deficiency of the fat soluble vitamins The recognition and treat ment of hypoprothrombinemia of vitamin K deficiency prior to operation are especially urgent Osteomalacia secondary to defective absorption of vitamin D and calcium is a not infrequent cause of fractures in patients with steatorrhea and the etiologic relationship must be recognized for proper management of the patient

Special nutritional problems are encountered in patients with gastro intestinal fistulas such as gastrocolic Impaired absorption due to the shunting of intestinal contents results in loss of calories nitrogen fat and vitamins *Prior to repair of the fistula* it may be impossible to pro vide sufficient calories and protein orally to correct the starvation In such instances however the proper parenteral supplementation of the patient includes sources of Calories protein (hydrolysate) and vitamins

Patients with peptic ulcer or with chronic obstructive lesions of the upper gastrointestinal tract have as a group low serum ascorbic acid levels Preoperative supplementation of this group with vitamin C is indicated

If elective procedures permit it is well to reduce obese patients prior to operation The surgical advantages are obvious Medically the needed operation delayed until weight reduction is accomplished may serve as an effective stimulus to the patient to carry through a successful reducing program

**Chronic Postoperative Nutritional Problems** Some surgical proce dures on the gastrointestinal tract create nutritional problems with which the surgeon should be familiar For example total gastrectomy is almost invariably followed in a period of time by the appearance of a macrocytic anemia which requires treatment with a hemopoietic vitamin or liver extract After partial gastrectomy patients often acquire a hypo chromic microcytic anemia This responds to therapy with iron and is most likely a result of the inadequate replacement of iron at the time of operation when transfusion has been the sole corrective procedure invoked Gastrectomy is often followed by impairment of fat absorption with resultant caloric deficit This may respond to frequent small feed

ings or it may be benefited by the use of some emulsifying agent such as Tweens

The creation of blind loops of intestine is to be avoided surgically where possible because of the relatively refractory macrocytic anemia which frequently follows

### METHODS OF FEEDING SURGICAL PATIENTS

Surgical patients may be fed orally through tubes introduced by the *nose and esophagus* into the stomach or jejunum through gastrostomy or jejunostomy tubes intravenously by hypodermoclysis or by rectum Each of these methods is useful under varying conditions In general the methods used should be the simplest The methods were cited in order of importance and no method low on the list should be used when a method higher on the list is practical

Before deciding to use such artificial methods as the intravenous one consideration should be given to the following questions Is the preparation to be used reasonably safe? Will the patient probably derive enough benefit from the food so that he will be better off than he would be with no food or with a lesser amount of food given by a simpler method? To answer these questions intelligently the surgeon will have to know much about the products he will use and will have to estimate the probable time during which an adequate intake by mouth or by tube will be impossible or unlikely

**Intravenous Feeding** Almost complete nutritional balance can be maintained by the intravenous route alone It is not advisable to use this however if it can be reasonably avoided because to do so entails the maintenance of an intravenous injection day and night which is wearing on the patient and unduly troublesome and expensive

The following important substances may be furnished intravenously

1 *Sodium chloride* and other soluble salts

2 *Calories* which may be furnished by glucose in distilled water or in saline solution Calories are also furnished by amino acid solutions or protein digests

3 *Protein equivalent* Protein other than human plasma serum whole blood red blood cells or globin cannot be given intravenously in quantities of nutritional significance *Mixtures of amino acids* however and protein digests for intravenous administration may be given and furnish as nearly as can be determined the exact nutritional equivalent of the substances from which the digests have been prepared provided certain amino acids destroyed in the process of making the preparations have been replaced There are three classes of such preparations acid hydrolysates enzymatic hydrolysates and mixtures of pure amino acids The last are not yet widely available For many purposes any of these three forms are useful However if acid hydrolysates are given in much over 3 per cent solution thrombosis of the veins is likely If some hydrolysates are given at the rate of over 20 gm of protein per hour nausea is likely Severe allergic reactions and even deaths have been reported but are extremely rare Patients must be watched closely when these injections are given and the injection must be stopped if

such symptoms as chest pain, flushing respiratory distress or severe head ache occur Great caution must be used if products derived from casein are given to patients who normally do not like or do not tolerate milk in their food

Many of the available preparations are put up in solutions containing an equal amount of glucose Most of them contain 2 gm of sodium chloride or less per liter The low content of salt is designed to reduce the chances of pulmonary or other edema if given to a patient with a low plasma protein

4 *Water soluble vitamins* that have been prepared in pure form may be given intravenously Fat soluble vitamins for intravenous use are not available but some of them are available for intramuscular use

5 *Human plasma and human serum* are frequently used for the treat ment of patients with depleted tissue protein Unfortunately, they have three serious defects when used for this purpose (1) They contain only about 18 gm of protein per 250 cc and this quantity will not go far to put patients in serious deficiency into balance Protein in this form, if bought on the open market, costs at least one dollar per gram If pro vided free, it still has this same value and has cost somebody this sum Such a price is low enough when these substances are used properly to treat or to prevent shock (2) The second defect is even more serious than the first Human plasma and human serum contain dangerously large amounts of sodium, and even when given in small quantities, this may cause acute pulmonary edema They both contain the 0 75 per cent of sodium chloride that was present in the plasma when it was drawn Plasma also contains an amount of added sodium even larger than the original that, in the form of sodium citrate is mixed with it to prevent clotting (3) Plasma and serum both may carry the virus of homologous serum jaundice The statistical danger of this is not great when individ ual units of plasma are concerned, but is multipled by the number of plasmas mixed together in pools Although this disease is usually mild it may be fatal and alone is sufficient reason for using plasma only when no other means of treatment is possible

6 *Whole blood and red blood cells* Students of the subject dispute whether or not blood cells are used by the system for nutritional pur poses The fact that under certain conditions of severe infection, in pa tients who are receiving insufficient protein and other food introduced blood disappears rapidly even in the absence of hemorrhage indicates that it may in part be used up in this way Whole blood contains about 70 gm of hemoglobin per liter and about 35 gm of plasma protein However, if the price of blood is fifty dollars per liter, this is still too high a price (fifty cents a gram) to pay for protein for nutritional pur poses It is especially important to see that the anemic, infected patient is so taken care of nutritionally that his system will not be forced to use up his own or any introduced blood for nutritional purposes

7 *Human albumin* Salt poor human albumin is also extremely expen sive when considered as a form of nutrition However, when a patient is in desperate condition with an extremely low plasma protein and with severe edema, as a result of burns or other surgical condition, it may

have a temporary life saving effect if given in doses of 100 or 200 gm of protein in a period of eight to ten hours It may re establish diuresis and reduce intestinal edema so that other intravenous or oral feeding at a suitable level may be given in quantities sufficient to put the patient into a positive nutritional balance Such doses of albumin may be repeated for a few days, but unless other means of feeding are established shortly, the original good effect will not be continued, since the caloric intake furnished by this amount of albumin is far below a maintenance level

*Intravenous Nutrition in Patients with Actual or Threatened Shock* The treatment of patients with actual or threatened shock due to or causing low blood volume is by the use of blood, plasma, serum, albumin or saline in such amounts and proportions that the plasma and blood cell volumes are restored or maintained When the use of one or more of the first four of these substances is indicated, this use has priority over all attempts to feed the patient, and it is neither safe nor practical to mix any nutritional supplement with these substances When saline solution is indicated, this priority changes Any patient that needs intravenous saline is probably not eating and is, therefore, out of nutritional balance Most of these patients have conditions that cause rapid utilization of calories, protein, and vitamins, and may have pre existing deficits to make up It is, therefore, important to add as many of these substances as possible and in optimum amounts to any saline solution that is given It is not practical to add protein hydrolysates or amino acid mixtures when saline is indicated, because these are salt poor solutions and the effective volumes are so large that it is better and safer to give such substances separately rather than as mixtures However, in nearly every instance in which saline is used the solution should contain 10 per cent glucose, rather than 5 per cent or none This will make available to the patient 400 Calories for each liter unless it is given so fast that some of the glucose is excreted None is likely to be excreted, except in diabetics who are not given sufficient insulin, if the rate is kept down to 250 cc per hour At the same time such patients can be given vitamins in the same bottle Vitamins may be needed for two reasons (1) the process of metabolism of glucose given intravenously uses up vitamins rapidly, (2) patients sick enough to need intravenous treatment are apt to need vitamins to alleviate previous or rapidly developing deficiencies If more than one such injection is given a day, vitamins do not need to be added to any of the injections after the first The doses of these vitamins should be ascorbic acid, 1 0 gm thiamine and riboflavin, 20 mg each niacinamide, 200 mg Of these, thiamine has a specific and important therapeutic effect on shock and the others have useful functions in correcting deficiencies

Glucose in distilled water, and amino acids, which are salt poor, are not indicated in the treatment of shock even if it occurs in the patient who has such a degree of edema from low plasma protein that the sodium chloride and sodium citrate in whole blood must make one cautious in regard to its use Salt poor albumin would be strongly indicated in such a case If it is used, the vitamins listed previously should be added to the first bottle of it used each day

*Regimen for Maximum Intravenous Feeding in Depleted Patients without Shock* When patients need maximum amounts of protein and carbohydrate, a considerable amount of each can be given intravenously To accomplish this the suggestion made by Butler and Talbot[12] should be followed They add 300 cc of 50 per cent glucose to 1000 cc of an enzymatic protein hydrolysate that is put up in a 5 per cent solution with 5 per cent glucose This mixture furnishes 50 gm of protein equivalent and 200 gm of glucose in 1300 cc of fluid Up to three bottles of this mixture may be given in twenty four hours if the injection is made continuously day and night Such a regimen has been given for a few days only to any one patient It furnishes 150 gm of protein equivalent and 3000 Calories Vitamins should be added in the amounts listed for use of the patient treated for shock Salt may be added if there is any indication for it, as there is in patients with burns or with extreme diarrhea or who have complete high intestinal obstruction, but it should be added cautiously because of the dangers of thrombosis and of edema If there are no periods of rapid administration very little glucose will be excreted in the urine of the patient without diabetes

**Intubation Feeding** Many surgical patients need tube feeding which may be given by stomach or duodenal tubes or by gastrostomy or jejunostomy tubes Such tube feeding may be needed because of an obstruction or merely to furnish supplemental food to the patient who cannot or will not eat as much food as he can digest The patients who need supplemental food introduced in this manner are usually sick, and care must be used in making up the formula and in deciding on the amounts so that nausea vomiting distention, diarrhea or any combination of these will not be induced In the past diets containing considerable amounts of fat have been recommended for such feeding However, if this feeding is to be given as a supplement to a patient with marked nutritional deficiency or with a continuing cause of deficiency, such as severe burns it is better to add no fat at all A complete diet may be given that is simple to make, inexpensive, and so complete nutritionally that it may be used as a sole source of food for months Such a formula is as follows

**Table 125 High Protein Tube-Feeding Formula**

| | Amount | Cbh | Pro | Fat | Calories |
|---|---|---|---|---|---|
| Skim milk | 1000 cc | 50 gm | 30 gm | 5 gm | 365 |
| Skim milk powder | 100 gm | 50 gm | 30 gm | 5 gm | 365 |
| Brewers yeast | 30 gm | 0 | 20 gm | 0 | 80 |
| Valentine's liver ext | 30 cc | 0 | 10 | 0 | 40 |
| Halibut liver oil | 4 cc | 0 | 0 | 4 gm | 36 |
| Vitamins* | 0 | 0 | 0 | 0 | 0 |
| Salt† | 5 gm | 0 | 0 | 0 | 0 |
| Total | 1100 cc | 100 gm | 90 gm | 14 gm | 886 |
| % of Calories | 0 | 45 | 41 | 14 | 100 |

* The water soluble vitamins to be added will vary with the condition of the patient Some patients may need as much as ascorbic acid 1 0 gm thiamine 30 mg riboflavin 30 mg and niacin 250 mg once a day

† Salt need seldom be added except for patients with large area burns

Twenty two hundred cubic centimeters divided into just over 1 pint to be given four times a day will give complete maintenance nourishment to most patients who have low caloric requirements Patients with high requirements may need 4400 cc of such a formula or even a stronger' formula If 4400 cc is to be taken, it is best to give it in aliquot portions (360 cc or 12 ounces) every two hours day and night

This formula may be made up once for a twenty four hour period, provided there is a good refrigerator to store it in The water soluble vitamins should not be added in the diet kitchen, but should be dissolved by the nurse on the ward and added immediately before the formula is fed It will be noted that no protein digests or proprietary proteins are included Essentially the same nutritional elements may be secured by mixing such foods with suitable carbohydrates into formulas However, there are few patients for whom this substitution results in a formula that is better tolerated or digested except those few patients who cannot digest such large amounts of milk protein because of an allergic reaction to it Such patients may also show allergic phenomena if a protein digest derived in whole or in part from milk is substituted for skim milk

If this occurs liquid diets without milk or nonliquid diets must be used Neither is as convenient to design, to make, or to give to such patients Toleration of foods, in the patient who has no food allergies depends on three factors the amount of food, the proportion of Calories furnished by protein, and the proportion of Calories furnished by fat If it is deemed necessary to increase the proportion of Calories furnished by protein above the 40 per cent found in the skim milk formula, then a whole protein, such as Casec, or a hydrolized protein, such as Protolysate, must be used If large amounts of Casec are used in a formula, difficulties arise as a result of its relative insolubility and the stickiness of the fluid which hinders its passage through the tube Several patients with burns have been maintained on diets in which 50 to 60 per cent of the Calories were furnished by protein, and one patient, with extensive unhealed burns, aged seven years and weighing 55 to 65 pounds was fed such a diet for more than one year through a jejunostomy tube During long periods of time his formula was as follows

Table 126 Very High Protein Tube Feeding Formula

| | Amount | Cbh | Pro | Fat | Calories |
|---|---|---|---|---|---|
| Skim milk | 1000 cc | 50 | 30 | 5 | 365 |
| Protolysate | 100 gm | 0 | 80 | 0 | 320 |
| Brewers yeast | 30 gm | 0 | 20 | 0 | 80 |
| Valentine s liver extract | 30 cc | 0 | 10 | 0 | 40 |
| Halibut liver oil | 4 cc | 0 | 0 | 4 | 36 |
| Vitamins* | 0 | 0 | 0 | 0 | 0 |
| Salt | 5 gm | 0 | 0 | 0 | 0 |
| Total | 1100 cc | 50 | 140 | 9 | 841 |
| % of Calories | 0 | 24 | 66 | 10 | 100 |

*Same vitamins as in the high protein tube feeding formula (Table 125)

During most of the time this formula was used it was given in amounts of 3300 cc per day Diets containing such a high proportion of Calories furnished by protein were seldom if ever given to such patients prior to 1946 Associated with this high intake of protein was a high output of nitrogen in the urine Many students of metabolic problems have stated that such a high intake of protein can serve no useful purpose and that, because of the high urinary excretion it puts a dangerous burden on the kidneys No renal damage has been seen in the cases cited Such diets have been used only because lower protein diets were obviously failing Whether theoretically important, they were practically so

### ORAL DIETARY SUPPLEMENTS

When a patient needs a high protein diet and can and will take the food by mouth there are many advantages in giving most or all of the food in liquid form In the first place a patient can frequently drink liquids when he cannot or will not chew and swallow enough solid food In the second place, nourishing drinks can be used to alleviate the difficulty that frequently arises from the patient's choosing the least important foods on his tray and leaving the more important A palatable milk drink can be made a *must* and be served before meals and between them Then, at meal time, the patient may be served a tray from which he can take what foods appeal to him if he has any appetite left for them It is difficult to disguise the unpleasant taste of some of the ingredients in the formulas given for tube feeding but some patients would rather drink these mixtures than be tube fed If a patient needs a high protein diet, the following will be found to be a useful and palatable drink

Table 127 High Protein Milk Drink

| | Amount | Cbh | Pro | Fat | Calories |
|---|---|---|---|---|---|
| Skim milk | 1000 cc | 50 gm | 30 gm | 5 gm | 365 |
| Skim milk powder | 100 gm | 50 | 30 | 5 | 365 |
| Chocolate syrup | 60 cc | 30 | 0 | 10 | 210 |
| Total | 1100 cc | 130 | 60 | 20 | 940 |
| % of Calories | 0 | 55 | 26 | 19 | 100 |

Vitamins do not need to be added to this formula since the patient who can swallow can take any needed vitamins in capsules

If it is desired to increase the proportion of Calories supplied by protein, Protolysate or Casec can be substituted for some of the skim milk powder at the cost of considerable decrease in palatability If the skim milk powder is completely replaced by Protolysate, the formula that results is as follows

Table 128 Very High Protein Milk Drink

| | Amount | Cbh | Pro | Fat | Calories |
|---|---|---|---|---|---|
| Skim milk | 1000 cc | 50 | 30 | 5 | 365 |
| "Protolysate | 100 gm | 0 | 80 | 0 | 320 |
| Chocolate syrup | 60 cc | 30 | 0 | 10 | 210 |
| Total | 1100 cc | 80 | 110 | 15 | 895 |
| % of Calories | 0 | 36 | 49 | 15 | 100 |

### *DIET IN SPECIFIC SURGICAL CONDITIONS*

**Peritonitis and Obstruction** The old rule that *nothing, not even water,* should be given orally in the presence of peritonitis and acute or partial intestinal obstruction still holds good In fact, the stomach and upper intestine must be drained in such cases and the drainage must be maintained until there is evidence that the intestine is again functioning The evidence consists in the passage of gas decrease of distention and the presence of normal intestinal sounds During the period of drainage, intravenous feeding is important After any necessary whole blood transfusions have been given 50 to 150 gm of protein digest and 200 to 600 gm of glucose should be given intravenously every day The latter should be given in sufficient saline solution but not more than sufficient, to correct deficiency and losses Vitamins as outlined earlier are also extremely important

When the time comes to start oral feeding after these conditions the start should be a gradual one so that during a period of three to seven days the amounts of intravenous feeding are reduced as the oral intake increases If nausea, distention, or vomiting recurs during or after this period, it is a sign that the patient is not ready for the regimen and oral feeding must be stopped During the first two or three days of oral feeding the drainage tube should continue in place A day by day regimen for such a patient is as follows

First Four Days

Apply suction to tube all the time Give small amounts of water orally Give daily intravenously

Amigen 1000 cc

Glucose 10 per cent in saline solution or distilled water with vitamins as above 1500 cc.

Fifth Day

Clamp tube except for ten minutes each two hours

Give 4 ounces of water immediately *after* each period of drainage

Same intravenous as first four days.

Sixth Day

Clamp tube all day

Give 4 ounces of water broth ginger ale or weak tea every two hours

Same intravenous as first five days.

Seventh Day

Remove tube.

Give 4 ounces of same fluids plus skim milk or fruit juices as desired

One half amount of each intravenous fluid

Eighth Day

Omit intravenous feeding

Give same fluids in amounts and at times desired Add oral vitamins in doses of approximately A 25 000 D 2500 U thiamine 12 mg riboflavin 12 mg niacin 200 mg ascorbic acid 300 mg

Ninth and Subsequent Days

Give low fat high protein diet as desired

**Diet during Study and Preoperative Treatment of Acute Abdominal Conditions without Peritonitis or Obstruction** During an attack of actual or suspected appendicitis cholelithiasis cholecystitis pancreatitis,

peritonitis, renal stone, pelvic inflammation, intestinal obstruction or severe colitis, nothing should be given orally and all food should be given intravenously until nausea, vomiting, distention, and pain have ceased, the danger of peritonitis has passed, and the patient is hungry. Intravenous feeding should be given as indicated for postoperative regimen.

**Diet after Abdominal Operations except Those on the Stomach and Intestines.** After any laparotomy there is a period of complete adynamic ileus that results from handling the peritoneum and intestines. Its duration varies in length with the condition of the patient and the severity of the operation. After an appendectomy for early appendicitis or after the repair of a small uncomplicated inguinal hernia this reaction is minimal. Such patients may be given liquids without milk or fruit juices ad libitum on the day of operation and such food as they feel like taking on subsequent days. Vomiting on the day of operation does no harm. It is usually due to the effects of the anesthetic and is not increased by the oral liquids taken. Intravenous feeding of 1500 cc. of 10 per cent glucose in saline solution with vitamins may be given on the day of operation, but healthy people do not usually need it.

After more severe operations such as cholecystectomy, hysterectomy, and combined abdominoperineal resections the postoperative ileus lasts longer and the regimen must be a more cautious one For such patients the following regimen is indicated

Day of Operation

Oral—water, 2 ounces ad libitum

Intravenous—after all necessary transfusions are complete 10 per cent dextrose in saline solution with vitamins, 1000 cc, protein hydrolysate, 5 per cent, 1000 cc

First Postoperative Day

Oral—liquids without milk or fruit juices, small amounts ad libitum

Intravenous—10 per cent dextrose in saline solution with vitamins, 1500 cc, 5 per cent protein digest, 1000 cc

Second Postoperative Day

Oral—liquids with skim milk and fruit juices and small portions of cereal or toast if desired

Intravenous—Same as first day except give glucose in distilled water

Third Day

Oral—same with additions of small amounts of low fat, high protein diet

Intravenous—the same as second day unless patient eats well In this case omit the protein digest.

Fourth Day

Oral—same, increasing the amount of food Add oral vitamins

Intravenous—omit glucose or protein digest or both

Fifth Day

Oral—full diet May shift to house diet if no remaining protein deficiency needs to be made up Continue vitamins

**Diet after Injuries, Infections and Operations Elsewhere than Intraperitoneal.** Adynamic ileus may follow these conditions as well as the intraperitoneal ones. In general, however, comparable duration of effects occurs only when the extraperitoneal injury is much more severe than

the intraperitoneal one According to the state of nutrition and the severity and duration of the illness intravenous feeding and high protein feeding may be necessary for short or long periods of time In general no oral food and little water should be given on the day of a severe injury or the day of long anesthesia for any condition

**Diet before Gastroduodenal Operations** Prior to nonemergency operations on the stomach and duodenum one problem is to prepare the patient in such a way that the stomach is empty and as clean as is reasonably possible To accomplish this the stomach must be drained for as long as needed If severe dilatation is present this may be a matter of days If no pyloric obstruction is present drainage of more than a few hours is unnecessary During such drainage no food should be given but water should be given ad libitum If the period is long full intravenous feeding with protein hydrolysate glucose salt and vitamins is extremely important Preoperative whole blood transfusions may also be necessary Usually the patient should come to the operating room with a tube in the stomach and it should be left in place during and after the operation

**Diet after Gastrointestinal Operations** The dietary problems after gastric operations are much easier now than they were formerly for the patient s strength can be maintained by intravenous feeding and single or double drainage tubes may be placed at the time of operation if they are needed

If two tubes are used one opening in the stomach and the other in the intestine below the anastomosis both should be connected to suction and suction maintained in both for at least twenty four hours After this time small amounts of water can be put in the lower tube However before each instillation an opportunity for drainage must be allowed because one cannot afford to distend the intestine if adynamic ileus is still present If intestinal function is established 2 ounces of skim milk and 2 ounces of water may be put in every two hours as early as the second day again allowing a period for drainage before each feeding The quantity and strength of this feeding may be increased rapidly so that at the end of a week both tubes are out and the patient is taking up to 2 quarts of skim milk or whole milk plus other bland food by mouth

If, as recommended by Wangensteen the longer tube is inserted through the anastomosis into the blind loop of duodenum it is used for drainage only and feeding is started through the stomach tube as given for an intestinal tube If a single stomach tube is used it is also handled in the manner outlined

During the period of no feeding or of partial feeding through or around these tubes full intravenous feeding is essential

In handling gastric patients postoperatively every precaution must be taken to avoid overfilling the stomach if dilation occurs the stomach should be emptied at once and completely After this feeding should be started again more and more food should be given cautiously

**Diet after Intestinal Resection** The problem after these operations is to avoid intestinal function for five to seven days so that the anastomosis

may have an opportunity to become well healed before it is tested by the passage of intestinal contents At first, besides being weak, anastomoses that are perfectly made may be functionally obstructed by postoperative edema of the wound Formerly the suture line was protected by the insertion of a tube drainage from a point above the anastomosis out through the abdominal wall and food could be given after the usual period following any intra abdominal operation Now many surgeons omit the drainage tube and provide drainage by a Miller Abbott tube If such a tube drains the intestine just above the anastomosis, food may be given fairly early However, if the patient had no intestinal obstruction before operation, no tube is usually necessary, but the patient should be given nothing but water orally for five to seven days and complete intravenous feeding must be given Feeding should only be started after there is evidence by the passage of gas, that function is established Early feeding should be cautious in amount and should be of low residue, nonirritating low fat and high protein composition

**Diet after Anal Operations** The dietary problem after operations for hemorrhoids, fistulas, and similar conditions consists in avoidance of a stool during the first four to five days while the wound is acutely painful Such patients are seldom in such poor condition that the loss of a few pounds of weight due to incomplete nutrition is of any moment Therefore, intravenous feeding is not customary However, these patients may be allowed liquids without milk or fruit juices and small portions of low residue cereals bread, and meat At the same time deodorized tincture of opium given three times a day will usually insure that no stool will be passed until the fifth or sixth day The first stool should be initiated by omitting the opium, giving a full meal and oral mineral oil giving a retention mineral oil enema the night before, and finally a saline enema on the fifth or sixth morning

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# 30

## *Nutrition in Industry*

ROBERT S GOODHART, M D *

The human being is a complex organism, reacting to and being influenced by a variety of environmental factors, and thus the direction of his activities is not a simple affair It is fundamental, however, that the worker must be maintained in good health if his energy output and efficiency are to be kept at their peak for any period of time True, great deeds have been accomplished by men and women in poor health, but there is a great distinction between achievements possible in situations of high emotional content, requiring the expenditure of energy for only short periods of time or at sporadic intervals, and the day in and day out labor of the industrial worker

Nutrition is but one of the many environmental factors involved in the maintenance of health It is, however, a basic factor which is becoming of greater and greater economic importance as the average age of the working population increases An experienced worker whether he be an executive or a machine operator, represents a tangible investment by industry It is to the advantage of industry and the country that the active, productive life span of such a man be prolonged as much as possible Optimal nutrition is essential to effect this

The four major causes of malnutrition, for workers as for the rest of the population, are poor food habits failures in provision, economic factors and metabolic stress Illness long working hours, extremes of temperature, strenuous work, insufficient rest and other conditions of stress not only increase many nutritional requirements, but also are frequently associated with deterioration in the diet The effects of nutritional deficiencies acquired during such periods of stress may be cumulative

The nature and uncertainty of his employment, his usual education, economic and social status, his hours of work and his urbanization make the average worker and his family extraordinarily vulnerable to food shortages, high food and other living costs, and poor dietary practices

Millions of American people are not eating the minimal amounts of all the essential food factors needed to keep them in good health In part, economic factors are to blame, every dietary study, or nutrition survey, of population groups has clearly shown the greatest incidence of poor diets, or of malnutrition, to be in the economically poorest

* Scientific Director, the National Vitamin Foundation Incorporated

third of the population However, economic factors are not, by any means the sole determining forces, as evidenced by the fact that poor diets and malnutrition occur in all economic strata Ignorance, food habits and prejudices, and problems of supply are responsible for a considerable proportion of the malnutrition in the United States

The studies of Stiebeling and Phipard[1] of the diets of families of employed wage earners in cities, during the period December, 1934, through February, 1937, showed that only 1 per cent of white families with a per capita food expenditure of $1 25 to $1 87 per week obtained a good diet, with 82 per cent receiving diets definitely poor in one or more nutrients Nine per cent of white families spending between $2 50 to $3 12 per capita per week for food received good and 53 per cent poor diets With food expenditures of $3 75 to $4 37 per person per week, it should not have been difficult to purchase a good diet in 1935 Yet only 23 per cent of such families actually had good diets, while 26 per cent had poor diets Obviously the quality of the food supply selected by families is not merely a matter of the per capita expenditure for food At every expenditure level above a certain minimum, some families succeed in obtaining good or fair diets while others fare poorly

It is the general impression that industrial workers tend to fare better in relation to their diets than do their families Studies of the food habits of workers themselves would, therefore, appear to be more to the point The first report of the Committee on Nutrition in Industry of the National Research Council[2] cites a number of surveys of lunches obtained by workers in plant cafeterias which agree in finding that not more than one half of the industrial workers observed selected good lunches from the cafeteria, even when a good choice was possible

An intensive study of the diets of 1103 Southern California Aircraft workers in November, 1941, through February 1942,[3] revealed that 56 per cent of these men ate less than the recommended amounts of green or yellow vegetables Forty nine per cent had none to four tomatoes or citrus fruits per week, 33 per cent had none to five glasses of milk per week Zero to one egg was eaten by 23 per cent, while only 1 per cent consumed meat as infrequently as twice a week For most of the men, an increased consumption of milk and of citrus fruits, tomatoes and certain green vegetables would correct the major deficiencies of riboflavin, calcium, and ascorbic acid and raise the intake of most other nutrients It is of interest that 85 per cent of the diets furnished the recommended amounts[4] or more of protein

Young men had somewhat better diets than the older men Men under twenty five years of age drank more milk and ate more citrus fruits than those twenty five years or older, but had a similar consumption of green and yellow vegetables and eggs

Practically all dietary studies of women workers agree that the female employees generally consume poorer diets than the male employees This is becoming a factor of major importance as the number of women in industry increases Dr John H Foulger[5] cited the instance of an English plant manager, in a chemical industry who found that an apparent sex difference in the incidence of gastric complaints, with a much

higher incidence among the female employees disappeared after improvement of the diets of the women

It is apparent that there is need for an intensive educational program However an educational program will not be effective if it is geared to reach the worker only through his home Good foods properly prepared and served must be made available to the worker on duty and he must be given the opportunity and time to take advantage of them

Many of the usual practices associated with the mass preparation and service of foods are accompanied by serious losses in essential food factors Assays of the thiamine riboflavin and ascorbic acid content of two meals taken off the serving table at the regular meal period in a large industrial cafeteria[6] revealed that in these instances no reliance could be placed on the foods cooked in the cafeteria kitchen for supplies of thiamine or ascorbic acid Eighty seven per cent of the thiamine content of one meal was provided by the meat potato and beans a condition associated with a 92 per cent loss of thiamine in the preparation of the meal The meat potatoes and carrots provided 40 per cent of the thiamine content of the second meal which showed a loss of 52 per cent of the total thiamine content in preparation There was an 82 per cent loss of ascorbic acid in the first meal which did not include any citrus fruit or tomato juice or salad The final ascorbic acid content of the second meal was practically all accounted for by the tomato juice present Much can be done to prevent food losses of this magnitude by educating food handlers on proper methods for the preservation preparation and service of foods Many experienced caterers are also greatly in need of advice on the relative nutritional qualities of different foodstuffs The plant manager is ill advised who entrusts a concessionaire with sole responsibility for the type of foods served to employees within the plant The plant manager should always provide for complete supervision by the plant physician or by a qualified nutritionist employed or designated by the plant over all food services offered to the employees within the plant

**In plant Problems Affecting the Nutritional Status of the Worker** *Special Dietary Needs* In general the food needs of the industrial worker are the same as those of any other person engaged in an equally active occupation and can be estimated from the table of Recommended Dietary Allowances of the Food and Nutrition Board of the National Research Council[4] Men working under conditions of high temperature may have increased demands for certain food factors However the nature and extent of any increased dietary needs except for water and salt are not well defined Talbott[7] considers a previous period of inadequate assimilation of food to be a predisposing factor to heat cramps He also has recommended[8] that in the treatment of dehydration from various causes dextrose may be added to salt solution and is specifically indicated if ketosis is present but it should not be given initially in place of saline solution The excellent book by Pyke[2] summarizes well the nutritional needs of workers in industry

*Heat stroke* is a critical emergency the only effective treatment for

which is to lower the body temperature by means of ice baths, ice enemas and, when the patient can cooperate, cool drinks It is essentially a failure of the heat regulating mechanism It is not closely related to the level of the salt in the blood and, unless accompanied by cramps[9] is not improved by giving salt

*Heat exhaustion* is a somewhat less critical emergency, best treated by having the patient lie quietly in a cool place Cool drinks may be ad ministered if desired by the patient

*Heat cramps,* while incapacitating and painful, are not dangerous to life for many hours, if at all The only effective treatment is replacement of the sodium chloride and water lost by the body Glucose, either alone or in addition to saline solution, has no real merit in the treatment of heat cramps[9] If carbohydrate depletion has occurred through inadequate diet, glucose may be of benefit in overcoming the depletion but it has no effect on the heat cramps and is no better than other sugars or other foods

Ill effects in men working under conditions of high temperature are least often seen among those who are in good physical condition who are acclimatized to work in the heat who eat a good diet who replace their water loss hour by hour and their salt loss day by day

Water should be available at all times Salt must be taken in adequate amounts each day Preferably, however, it should not be taken during the working day, but should be taken with meals and during rest pe riods, and especially after the conclusion of the day s work[9,10] Johnson[9] states that the total daily intake of salt for 'the average man needs to be about ½ gram for every hour of rest and about 2 grams for every hour of work that is hard enough to cause profuse sweating That is the average sedentary person in hot weather needs about 12 grams a day the average man working a hard eight hour day about 24 grams The recommendations of the Food and Nutrition Board[4] on salt are as follows

> The needs for salt and for water are closely interrelated A liberal allowance of sodium chloride for the adult is 5 grams daily except for some persons who sweat profusely The average normal intake of salt is 10 to 15 grams daily an amount which meets the salt requirements for a water intake up to 4 liters daily When sweating is excessive one additional gram of salt should be consumed for each liter of water in excess of 4 liters daily With heavy work or in hot climates 20 to 30 grams daily may be consumed with meals and in drinking water Even then most persons do not need more salt than usually occurs in prepared foods It has been shown that after acclimatization persons produce sweat that contains only about 0 5 gm to the liter in contrast with a content of 2 to 3 grams for sweat of the unacclimatized person Consequently after acclima tization need for increase of salt beyond that of ordinary food disappears

The water soluble vitamins thiamine and ascorbic acid are lost in the sweat to a minor extent Johnson[9] states that we have seen no benefit from administering during work either vitamin C or yeast Weaver was cited by Foulger[5] as having observed beneficial effects from the administration of ascorbic acid to men working in high temperatures However, as these men were working in the presence of a toxic chemical it is possible that the effects noted were not due to increased losses in the sweat, but rather to increased utilization brought about by increased

vaporization of toxic chemicals and increased absorption of such substances through the skin

Foulger[5] studied the effects of the administration of 100 mg daily of ascorbic acid to workers in the munitions industry and found indications of a beneficial effect as determined by the incidence of abnormal results on the Crampton test Confirmatory studies from other laboratories are not available However, in the experimental animal, ascorbic acid promotes the detoxification of a number of substances such as the barbiturates paraldehyde chloretone and aminopyrine[11] and diphtheria toxin [12]

Ascorbic acid is apparently not an effective prophylactic agent for *lead poisoning* and has little merit as a therapeutic agent in this condition Pillemer and co workers[13] found a much greater incidence of neuro plumbism and a higher mortality rate in guinea pigs maintained on a low ascorbic intake and administered lead carbonate than among chronically poisoned guinea pigs on a high ascorbic acid diet The vitamin was not significantly protective against weight loss anemia and stippling

Milk may be of some value in the prophylaxis of lead poisoning [23 24 25] but we have been unable to find any factual data justifying the reputation widely enjoyed by milk as a preventive of toxic reactions in the manufacture and handling of trinitrotoluol dinitrotoluol nitroglycerin and similar compounds

*Between Meal Refreshments* The Committee on Nutrition in Industry of the National Research Council[2] and the United States Public Health Service[14] have highly recommended the institution in industry of between meal rest periods together with an opportunity of obtaining food The Nutrition Service of the Department of Pensions and National Health of Canada has made a like recommendation [15] Ideally between meal rest and refreshment breaks should be spaced midway between the regular meal periods As it is obviously impossible for any plant to so arrange the eating schedule of all its employees it is recommended that the practical procedure of establishing ten minute rest and refreshment periods two to two and a half hours before and two to two and a half hours after the midshift meal period be adopted It is not sufficient merely to provide readily assimilable carbohydrate at such feedings It is important to remember that food taken between meals is an integral part of the diet as a whole Haggard and Greenberg[16] pointed out that the diets of many workers are deficient in vitamins and minerals or verge on such deficiency Supplementary feedings with foods containing only carbohydrate further exaggerate these deficiencies This feature of supplementary feeding constitutes the only valid criticism against eating between meals

There is apparently little justification for the often repeated assertion that dextrose is an especially valuable source of ready energy for industrial workers Murlin[17] stated that the difference in the time of absorption between sugar and starch is not great enough to favor sugar over starch as a greatly superior source of ready energy According to Murlin [18] experiments in our own laboratory show that in thorough salivation of cooked starch sugar is formed within fifteen seconds and

this digestion continues in the stomach for at least one half hour under ordinary circumstances and often much longer Borsook[10] is of the opinion that, for the industrial worker, no special case is to be made for glucose or carbohydrate as a source of energy, quick or otherwise John son[9] believes that 'men doing violent work in the heat (e g, marathon runners) may benefit from ingesting glucose during the work This is because they are able in a few hours to deplete their reserves For the average worker, this situation does not arise, provided he gets three square meals a day In fact, there is a possible danger of hypoglycemia if a sedentary worker ingests glucose infrequently enough to show the well known phenomenon of low blood sugar following high blood sugar If the blood sugar is low, mixed foods are better than pure glucose or other sugars because of their more prolonged action" Wilder[19] similarly expressed a belief that, for industrial workers, mixed foods are more desirable than pure carbohydrates because of their more prolonged effect upon the blood sugar level and because the administration of sugar, if not repeated frequently enough, may lead to hypoglycemic reactions considerably more severe than the one which motivated the ingestion of the sugar

That the vitamin content of between meal feedings may be fully as important as the caloric content is suggested by the work of Bollman[20] who found that vitamin depleted rats receiving dextrose and thiamine survived two to four times as long as those receiving only dextrose

It is recommended, then, that between meal feedings consist of more than pure or nearly pure sugar and that the foods offered contain sig nificant amounts of the vitamins and minerals necessary for their metab olism They must also be of a kind that will permit ready service and ingestion, with a minimum amount of preliminary preparation on the part of the worker who is to consume them Milk, citrus fruit juices tomato juice, fruits and sandwiches made with enriched or whole grain breads and substantial fillings, are suitable

*Other In plant Problems* Other in plant problems which affect the nutritional status of the industrial worker include the length of the midshift meal period, work on swing and night shifts, and the frequency of shift change

The time utilized by workers for the actual consumption of their mid shift lunches has been estimated to vary from ten to fifteen minutes Workers who eat the more substantial (and more desirable) lunches generally approach the upper limit of this range It is obvious, then, that decisions on the length of the lunch period to be permitted should be based on the provision of a minimum of fifteen minutes for the actual consumption of the food The over all length of the lunch period may vary according to the adequacy and convenience of the feeding facilities and lunch rooms, and the amount of preliminary toilet and other prepara tions which the worker must perform before eating It is unlikely that a lunch period of less than thirty minutes would prove adequate, except under exceptional circumstances, and longer periods frequently may be necessary

The desire of some workers to work through their lunch periods with

out stopping to eat a good meal, in order to shorten their working day, increase their income, or out of patriotic motives, should be discouraged Such practices tend to impair health and decrease working efficiency, if continued over any period of time

Workers on the swing and night shifts are particularly apt to suffer be cause of inadequate nutrition, not because their requirements are greater than those of day shift workers, but because their living and eating condi *tions are apt to be much worse Frequently plant eating facilities* except for vending machines and some refreshment stands, are not available to them, and community restaurants, except for a few short order stands, are closed Frequently such a man arrives home from work at an hour when it is not reasonable to expect that his wife or landlady will have a meal prepared for him

It is often possible for the plant management or a labor representative to make arrangements with a neighborhood restaurant to stay open by guaranteeing the restaurant management a certain amount of business and getting the workers to cooperate Or the plant may arrange to have its own cafeteria open for these workers so that they can get a good meal at the midshift period and a light snack when they leave work or just before they leave

Frequent shift changes cause disruption in home life and in living and eating routines The United States Public Health Service[14] has recommended that, in plants operating on a twenty four hour schedule, shifts should not be rotated more often than every two or three months Women with home responsibilities often try to do their housework dur ing the day while working on night shifts Chronic fatigue in short order is the result In general, women workers who also have domestic duties should not be employed on the night shift[14] It has also been found that the loss of regular sleep is more serious for young workers who have not attained full growth, hence young girls should not be placed on the night shift[21]

**Food Concentrates and Synthetic Vitamins** Many industrial concerns have adopted the practice of distributing polyvitamin preparations to their employees or of making them available at cost Such preparations are harmless, and dietary deficiencies are prevalent There are, however, other vitamins, minerals and an undetermined number of vaguely de fined food factors which are essential to the human economy, in addition to the essential amino acids, certain fatty acids and calories Obviously one is not in a position to assure industrial workers that they can main tain themselves in optimal nutritional health simply by ingesting a certain number of vitamin capsules or vitamin mineral preparations daily This does not mean that vitamin concentrates or synthetic vita mins are not to be used when it is impossible to obtain the quantities of the vitamins necessary for good health from available foods, however, with or without the use of the synthetic vitamins every effort must be made to supply adequate meals to the workers

Physicians who have worked with nutritional deficiency diseases, or who have had mass feeding experience, know that there are situations in which it is not advisable to depend upon the available supply of what

are commonly considered natural foodstuffs for adequate amounts of all the essential food factors It is difficult for example even for the nutritionist to plan a moderate cost acceptable dietary which meets the Food and Nutrition Board s recommended allowance for riboflavin without including a pint of milk or its equivalent in milk products in the daily diet Also it is difficult to obtain the recommended quantities of niacin unless meat is included in the diet When there is an excessive loss of salts or vitamins from the body when energy output and therefore metabolic requirements for these substances are extraordinarily high or when therapeutic amounts are indicated the need for the administration of particular vitamins or salts in quantities greater than can be obtained in customary foods may be present Such needs should be defined by the physician

Again when the available supply of foodstuffs cannot be depended upon to satisfy even the average requirements for certain essential food factors either because of deficiencies in supply or because of irremediable losses in the storage transportation or preparation of foodstuffs indications for the use of food concentrates or synthetic vitamins may be present

*Midshift Meal It is recommended that midshift meals supply at least* one third of the daily nutritive requirements In many instances it is desirable for industrial concerns to make provision for feedings during *the working day that supply at least two thirds of the worker s daily re*quirements This is especially indicated where the workers must come long distances to work and therefore fail to obtain proper breakfasts where housing conditions are poor and community restaurant facilities inadequate where many single men and women not living at home are employed and in the case of swing and night shift workers

That it is generally a simple matter to devise menus that will provide at least one third of the day s nutritive requirements in one meal and two thirds by means of one midshift meal plus one between meal feeding can be seen from an examination of the examples given at the end of this chapter There is nothing intrinsically meritorious from the standpoint of nutrition, about a hot meal It is possible for a cold meal to be equally if not more nutritious Hot dishes do have a certain morale lifting value and are particularly appreciated in cold weather They should be provided therefore when possible

***Table 129 One Large Feeding Fulfilling One-Third Day's Food Requirement***
**(National Research Council Standards for a Moderately Active Man)**

Standard

| Calories | Protein | Calcium | Iron | A | $B_1$ | $B_2$ | C |
|---|---|---|---|---|---|---|---|
| 1000 | 23 gm | 0 3 gm | 4 mg | 1666 I U | 0 5 mg | 0 7 mg | 25 mg |

Menu No 1*

1 ham sandwich
1 American cheese and lettuce sandwich
Mayonnaise
½ pint milk
½ pint orange juice

| Calories | Protein | Calcium | Iron | A | $B_1$ | $B_2$ | C |
|---|---|---|---|---|---|---|---|
| †1204 | 23 gm | 0 884 gm | 3 53 mg | 2445 I U | 1 0 mg | 0 93 mg | 117 mg |

Menu No 2*

1 cheese sandwich
1 chopped dried beef and egg sandwich
Mayonnaise
½ pint milk
½ pint grapefruit juice

| Calories | Protein | Calcium | Iron | A | $B_1$ | $B_2$ | C |
|---|---|---|---|---|---|---|---|
| †1197 | 51 gm | 0 887 gm | 6 35 mg | 2005 I U | 0 68 mg | 0 922 mg | 80 mg |

Menu No 3*

1 hamburger or chopped beef sandwich
1 sliced tomato and lettuce sandwich
Mayonnaise
½ pint milk
8–10 dried prunes

| Calories | Protein | Calcium | Iron | A | $B_1$ | $B_2$ | C |
|---|---|---|---|---|---|---|---|
| †1066 | 33 gm | 0 381 gm | 6 43 mg | 4220 I U | 0 7 mg | 0 895 mg | 31 mg |

Menu No 4*

*1 chopped liver or roast beef sandwich*
1 peanut butter sandwich
½ pint milk
½ pint tomato juice

| Calories | Protein | Calcium | Iron | A | $B_1$ | $B_2$ | C |
|---|---|---|---|---|---|---|---|
| †973 | 31 gm | 0 351 gm | 6 41 mg | 6805 I U | 0 62 mg | 1 438 mg | 62 mg |

Menu No 5*

2 ham and egg sandwiches
Mayonnaise
½ pint milk
½ pint tomato juice

| Calories | Protein | Calcium | Iron | A | $B_1$ | $B_2$ | C |
|---|---|---|---|---|---|---|---|
| †1037 | 39 gm | 0 326 gm | 3 81 mg | 2805 I U | 0 83 mg | 0 757 mg | 43 mg |

Menu No 6*

*1 sardine and onion sandwich*
1 cheese sandwich
½ pint milk
½ pint tomato juice
3 tablespoons roasted peanuts

| Calories | Protein | Calcium | Iron | A | $B_1$ | $B_2$ | C |
|---|---|---|---|---|---|---|---|
| †1230 | 57 gm | 0 816 gm | 3 81 mg | 3505 I U | 0 56 mg | 1 339 mg | 43 mg |

**Table 130 Two Feedings per Shift Fulfilling One Half Day's Food Requirement**
**(National Research Council Standards for a Moderately Active Man)**

Standard

| Calories | Protein | Calcium | Iron | A | $B_1$ | $B_2$ | C |
|---|---|---|---|---|---|---|---|
| 1500 | 35 gm | 0 4 gm | 6 mg | 2500 I U | 0 7 mg | 1 0 mg | 37 mg |

— feeding

*2 slices bread (enriched)*
1 egg or the sandwich filling in the menu
2 teaspoons butter
½ pint tomato juice

| Calories | Protein | Calcium | Iron | A | $B_1$ | $B_2$ | C |
|---|---|---|---|---|---|---|---|
| †537 | 23 gm | 0 312 gm | 2 52 mg | 2685 I U | 0 35 mg | 0 628 mg | 43 mg |

* Enriched white bread and four teaspoonfuls of butter or fortified margarine are used in making all sandwiches

† All values are approximate

Table 131 Two Feedings per Shift Fulfilling Two-Third Day's Food Requirement
(National Research Council Standards for a Moderately Active Man)

| | | | Standard | | | | |
|---|---|---|---|---|---|---|---|
| Calories | Protein | Calcium | Iron | A | $B_1$ | $B_2$ | C |
| 2000 | 46 gm | 0 6 gm | 8 mg | 3332 I U | 1 0 mg | 1 4 mg | 50 mg |

The full menus as suggested could be given at each of the two eating periods

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25 Cantarow, A, and Trumper, M Lead Poisoning Baltimore, Williams & Wilkins 1944

# Appendix

## SPECIAL METHODS OF FEEDING

Special methods of feeding are sometimes useful during a critical period but they seldom suffice long as the only method of nourishment They may save life but they should be looked on always as makeshifts

**Gavage** Feeding through a tube introduced into the stomach may be used when there is difficulty in swallowing or when for other reasons the patient is unable to eat or refuses to take food The stomach tube passed in the usual manner or a small tube passed through the nose may be used The latter method is usually preferable if this form of feeding is to be long continued

**Nasal Feeding** The small duodenal tube carrying a long wire stylet is passed through the nose and pharynx until the mark on the tube indicates that it has reached the stomach The stylet is withdrawn and if the tube is to remain in the stomach it can be attached to the nose and cheek by means of adhesive tape Care must be taken in an unconscious patient to be sure the tube is not in the larynx

Any liquid food is suitable Milk should be the chief food to which may be added eggs cream and sugar in reasonable quantities Thin gruels and bouillon may also be used Formulas suitable for intubation feeding are given in Chapter 29 (q v ) The food is forced through the tube by means of a syringe (50 cc ) or by gravity from a funnel or a gravity flask A three way syringe has been devised for this purpose If the tube is kept in place feedings should as a rule be at intervals of two to four hours a half pint to a pint to be given each time After each feeding the tube should be cleansed by the passage of a little water and then air

**Duodenal Feeding** This kind of feeding was devised by Einhorn for cases in which it is desirable to rest the stomach He recommended it particularly for patients with severe gastric or duodenal ulcer intense nausea or vomiting or pronounced gastric atony The Einhorn tube or some other tube devised for this purpose is passed into the duodenum in the usual manner and may be permitted to remain in place for a time The presence of the tube in the duodenum can usually be recognized by the slight tug which is felt when the tube is gently drawn on or by the color and alkaline reaction of the aspirated fluid The same kind of liquid food should be used as that advised for nasal feeding We have not been able to find in duodenal feeding the great advantages which have been claimed for it A patient with peptic ulcer who requires this type of alimentation should have the benefit of operation

**Nutrient Enema.** This furnishes a means of giving water to the patient who for any reason cannot be adequately fed by stomach There are, however, definite limits as to the quantity and kind of food which may be given in this manner Instances are recorded in which patients were kept alive for long periods by means of nutrient enemas, but it can safely be said that the usefulness of this method of feeding is as a rule limited to a few weeks (from two to six) A patient nourished solely in this manner obtains at best only from one fourth to one third of the nutriment necessary to meet his basal needs The remainder comes from the oxidation of his own tissues The injected material does not go beyond the ileocecal valve, unless perchance that valve is incompetent, and all absorption, therefore, as a rule takes place in the colon Since the large intestine is intended chiefly as a reservoir in which no appreciable digestion takes place and from which only water and salts are normally absorbed, its usefulness as an organ of nutrition is obviously limited

There is little or no utilization of protein given by rectum The older formulas for nutrient enemas usually included such protein foods as milk and eggs, but the rationale of their use will not stand scrutiny Boyd[1] reported results which indicated that 'protein food, even when predigested and with salt added, is very poorly absorbed in rectal feeding' Short and Bywaters[2] concluded that practically none of the protein of peptonized milk and eggs prepared in the ordinary manner was utilized They suggest that if any nitrogen food is absorbed from the large intestine, it must be in the form of amino acids Protein hydrolysates have been used for this purpose, but since these substances can be given intravenously with much greater assurance of utilization, their use by enema, except under unusual circumstances, is of doubtful propriety

The nutritive value of fats given by enema is doubtful The authors just quoted think they are of little if any value Alcohol in dilute solution (up to 2 per cent) is readily absorbed and utilized

Glucose is commonly believed to be promptly absorbed from the colon and readily utilized Recent experiments indicate, however, that this is not true and that such absorption as takes place when this substance is given by rectum occurs in the small intestine Horsley[3] quoted McNealy and Williams, who studied absorption from isolated loops of colon and ileum and found that, while tap water and salt solutions are taken up readily, there is practically no absorption of dextrose from the colon From this one would conclude that a dextrose enema has no nutritive value unless the ileocecal valve is incompetent Fortunately, however, to judge by roentgenographic appearances, this valve is incompetent in a large proportion of sick persons When it is desired to give glucose per rectum, it should be administered in strengths of 5 to 10 per cent Stronger solutions may cause discomfort It may be given as pure dextrose or as commercial corn syrup

**Subcutaneous Feeding** Subcutaneous feeding of carbohydrate and fat possibly holds something of promise, but the amount of food which may be given in this way is inconsiderable This method of feeding is not of practical value

**Intravenous Feeding** Since the introduction of protein hydrolysates intravenous feeding has become an established procedure Water, salts, carbohydrates, vitamins and amino acids can be given in this manner Water and salts are given in isotonic salt solution in any needed amount as is dextrose in 5 per cent solution Thiamine, riboflavin, ascorbic acid and nicotinic acid in pure crystalline form can also be given in this manner

*Protein hydrolysates* deserve special mention because of the wide spread enthusiasm that has greeted their introduction They are undoubtedly of enormous value but in defining their exact sphere of usefulness a certain amount of conservatism is still necessary The reader is referred to the excellent articles by Allison,[4] by Werner[5] and by Elman [6] Werner concludes his review with the comment that 'Critically controlled observations are still needed to evaluate the proper place of parenteral hydrolysate and amino acid therapy in man '

Fat in the form of a fine emulsion has been given intravenously [7] The problem of providing emulsions for routine use has not been solved Intensive developmental work is under way in this area [8,9] For a complete discussion of methods of intravenous feeding the reader is referred to Chapter 29

## THE STORING AND PROCESSING OF FOODS

The complexities of modern civilization demand that foods be stored over long periods and transported great distances The keeping qualities of foods must, therefore, be artificially improved This is accomplished as a rule by one of three methods (*a*) the addition of heat, as in canning (*b*) the withdrawal of heat, as in freezing, and (*c*) the withdrawal of water, as in dehydrating While the food is improved in one respect, however, it is often injured in another, its nutritive qualities are impaired The extent of this impairment and its prevention are the subject of active investigation *

The *storage* of vegetables and fruits at room temperature is accompanied by appreciable losses in nutritive values Vegetables are especially vulnerable in this respect Spinach has been found to lose half its ascorbic acid in three days and nearly all of this vitamin in seven days Parsnips stored in a pit throughout the winter lost more than half of their content of this vitamin Such losses do not occur at comparable rates however, in all vegetables The losses of broccoli and cauliflower are much less under similar circumstances than those of spinach Sweet corn does not suffer appreciable losses in ascorbic acid as long as its other good qualities remain In three stages of ripeness bananas were found to contain green, 6 1 mg of ascorbic acid per 100 gm, yellow, 6 3 mg and fully ripe, 7 3 mg Bartlett pears were found to drop from 9 to 4 9 mg in ascorbic acid values per 100 gm during the first two months of storage, thereafter there was no appreciable drop

* An excellent review of this subject is given in Kohman's special article [10] from which many of the data given in this section were taken

Table 132 Average Values for Ascorbic Acid (Kohman)

| | Broccoli | Spinach | Peas | Asparagus | Snap Beans |
|---|---|---|---|---|---|
| As purchased on wholesale market | 70 | 35 0 | 15 5 | 12 5 | 10 0 |
| 24 hours later at 70° F | 60 | 20 0 | 14 8 | 10 0 | 8 5 |
| 48 hours later at 70° F | 50 | 18 5 | 14 0 | 10 0 | 7 5 |

*Canning* has as its chief object the destruction of spoilage organisms This process results in minimal losses of vitamin A or, when properly done of vitamin C The loss of thiamine in vegetables is not great but the experience of Arnold and Elvehjem in processing meat would indicate that these losses run up to 80 per cent of the thiamine content This is attributed to the higher $pH$ at which meat is canned In some respects the food is improved by canning The calcium and in certain instances the vitamin A values of canned foods are more readily utilized than those of the fresh product The effect of heat on protein quality is variable [11] but any loss of quality during canning is not serious

The *freezing* of fruits and vegetables is satisfactory if they are first blanched for a few minutes in water at or near the boiling point in order to kill the enzymes which remain active at very low temperatures The difficulty is that the heat thus applied also kills the oxygen consuming enzymes and permits the product thereafter to become saturated with oxygen This becomes of serious concern when thawing is permitted because it leads to the rapid destruction of essential substances notably of vitamin C Pears for example thawed for thirty minutes lost 27 per cent of their vitamin C within the hour Even at 4 5° C 25 per cent of this vitamin was lost in twenty four hours The freezing of vegetables is accompanied by little or no loss of vitamins however provided (*a*) that they are frozen quickly (*b*) that a low storage temperature is maintained constantly and (*c*) that thawing is prevented until immediately before they are to be cooked for the table

The *dehydration* of fruits and vegetables gives great promise as a method of preservation, but this promise is as yet far from being fulfilled The results reported are highly contradictory

Two difficulties present themselves The food often has a haylike flavor and for other reasons is unpalatable This objection it is said can be overcome if the dehydration has been properly done and if the food is skilfully prepared Indeed it is claimed that under proper circumstances the dehydrated product when served at the table cannot be distinguished from the fresh vegetables

The greatest difficulty, however is in the loss of nutritive substances which results from dehydration As for vitamin A Tressler[12] states that if in order to inactivate a destructive enzyme the vegetable is either heated rapidly prior to dehydration or is dehydrated in the almost complete absence of oxygen relatively little loss will occur In the case of

thiamine available data would indicate that little if any loss may be expected The destruction of ascorbic acid presents the greatest difficulty, but there are means for inactivating the enzymes responsible for this loss One of the most effective of these is sulfuring but as has been pointed out by Kohman the sulfur probably destroys thiamine just as effectively as it protects ascorbic acid No data are at hand to tell of riboflavin losses in dehydration, but since this vitamin is relatively stable to heat, it can be anticipated that if light is excluded such losses will not be great

In the dehydration of fruits the loss of vitamin A values is variable All or almost all the ascorbic acid is destroyed unless the fruit is sulfured and dehydrated and is also protected from direct sunlight Even then the result depends somewhat upon the nature of the fruit Thiamine is destroyed during dehydration to the extent of one third to one half of *that contained in the fruit, much more (possibly all) is destroyed if the* fruit is sulfured No data are available concerning the loss of riboflavin, nicotinic acid or other vitamins in the dehydration of fruits

In brief it is impossible to give consistent figures concerning the losses in vitamins occurring in vegetables and fruits during dehydration In certain instances it is claimed that these losses are so small as to be negligible in others, the losses reported would credit little remaining of nutritive value to the vegetable Progress is being made, however, and the industry is being standardized It can reasonably be expected that dehydrated vegetables and fruits of proved nutritive value will eventually be available

*Cooking* is accompanied by losses in nutritive value which can be charged to a much greater degree of oxidation than to heat This is especially true of the destruction of vitamin C Heat is necessary, but oxygen can be excluded Slow cooking of turnip greens for example caused a loss of 23 8 to 36 5 per cent of ascorbic acid, but rapid cooking with a constant rise of steam to blanket off the atmospheric oxygen was accompanied by only 15 5 to 26 7 per cent loss In the cooking of potatoes the loss of this vitamin was found to become progressively greater with the following methods steaming boiling baking and pressure cooking In the cooking of cabbage an actual loss of 10 to 30 per cent, depending on the method is reported but as much as 66 per cent was extracted in cooking water *Much of the loss which occurs in boiling can be avoided* if the water is kept at a minimum and is used

Thiamine losses are not necessarily great in cooking Aughey and Daniel[13] found no thiamine loss in the pressure cooking or boiling of carrots the loss in baked potatoes was 16 per cent, in boiled spinach 22 per cent in simmered peas 9 per cent, and in boiled beans 18 per cent The losses were much greater when soda was added In baked bread, there was 14 per cent loss of thiamine, in braised loin of pork 15 per cent and in roast pork 43 per cent This loss of thiamine in the cooking of meat was found by Michelsen, Waisman and Elvehjem[14] to be less in fried meats The nicotinic acid and riboflavin of meats are stable in most cooking processes

## *Methods of Cooking*

It is not within the province of this book to attempt the teaching of cooking or the preparation of food Physicians who advise their patients concerning diet, however, are frequently called upon to criticize the preparation of food and to offer suggestions for not infrequently a patient suffers from nutritional failure because the food at his disposal is poorly prepared, unappetizing and perhaps indigestible The following suggestions were taken from the report of Margaret A B Fixsen concerning the influence of cooking and canning upon the vitamin content of human foods

The details considered to be relevant of the most important cooking methods are briefly given below

**Boiling** Sufficient water is added to cover the material which is allowed to boil briskly in the case of fruit or vegetables or to simmer in the case of meat Great variation occurs in the proportion of water to solid material used Olliver states that the ratio of the first to the s [illegible]
are put into boi [illegible]
vidual practice [illegible]
on to preserve the original green color as far as possible

**Steaming** is carried out in either a double saucepan or a tiered steamer In the latter case the material to be cooked is usually contained in a basin in the upper part of the steamer and covered with greased paper to protect it from the condensed steam Only a very small amount of water is added so that the material cooks in its own juices and these are entirely retained When vegetables are cooked in the steamer on a wire grid instead of in a vessel there is some loss of juice

**Conservative vegetable cookery** consists in cooking the material with a little added water or fat very slowly in a covered vessel either in a slow oven or directly over a very low flame Steaming and conservative methods are often recommended for vegetables in preference to boiling because the juices are consumed with the solid matter and losses of mineral salts and other water soluble material into the cooking water are thereby avoided On the other hand the period of exposure to heat being prolonged the destruction of heat labile constituents is increased Furthermore the vegetables lose their green color and acquire a somewhat unappetizing brown tint The stronger flavor developed is often unwelcome but this is probably largely a question of habit

**Stewing** Meat and vegetables immersed in water or in previously prepared gravy are cooked slowly until tender The tenderness of the meat and the volume of the stew determine the length of time needed to complete the cooking process but this is never less than 1 hour and may extend to 4 or 5 In haybox or cooking box" methods the stew after being brought to the boil is placed in the center of a box so constructed that the loss of heat is very largely prevented by insulation with some material such as hay The rate of cooking is thus reduced and the stew can be safely left for long periods without fear of overcooking

**Roasting and Frying** In both these methods the cooking medium is hot fat They are rapid methods in which loss of juices is to a considerable extent avoided The high temperatures reached however tend to damage heat labile substances

**Baking** The temperatures used for baking depend on the material Puff pastry and bread need external temperatures of about 177° C (350° F) small cakes and other types of pastry 160° C (320° F) whereas for puddings and large cake lower temperatures are sufficient Since these materials contain a large proportion of water the temperature attained internally is much lower than the external temperature Milk puddings are best baked at the lowest temperature consistent with proper bursting of the starch granules.

**Vegetables** In the cooking of the commoner vegetables the following are the methods of choice [15]

| Bake | Steam | Boil (in Open Kettle) |
|---|---|---|
| Irish potatoes | Sweet potatoes | Spinach |
| Sweet potatoes | Squash | Green peas |
| Squash | Parsnips | Green beans |
| | Carrots | Cabbage |
| | Yellow wax beans | Brussels sprouts |
| | Beets | Cauliflower |
| | Spinach | White turnips |
| | Green peas | Yellow turnips (rutabagas) |
| | Green beans | Onions |
| | | Red cabbage |

**Meats** The chemical changes which take place in meats as the result of cooking are illustrated in the following table taken from Rogers Gillum Kunerth and Pittman[16]

**Table 133 Effect of Roasting on Composition of Paired Cuts of Steer Beef**

| Sample Number | Cut | Official U S Grade | Preparation | Fat (per cent) | Protein (per cent) | Total Solids (per cent) | Moisture (per cent) | Total Ash (per cent) | Calcium (per cent) | Phosphorus (per cent) | Iron (per cent) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| VIII | Clod | Good | Uncooked | 18.2 | 21.1 | 41.2 | 58.8 | 0.964 | 0.012 | 0.156 | 0.0023 |
| XIII | | | Roasted | 22.0 | 25.3 | 52.8 | 47.2 | 1.060 | 0.006 | 0.211 | 0.0026 |
| IX | Ribs | Good | Uncooked | 31.0 | 19.8 | 51.8 | 48.3 | 0.812 | 0.009 | 0.136 | 0.0018 |
| XII | | | Roasted | 32.6 | 31.9 | 64.9 | 35.1 | 1.065 | 0.008 | 0.199 | 0.0021 |
| X | Top round | Good | Uncooked | 6.6 | 24.1 | 31.9 | 68.1 | 1.162 | 0.005 | 0.200 | 0.0022 |
| XI | | | Roasted | 9.0 | 30.6 | 39.3 | 60.7 | 1.117 | 0.011 | 0.214 | 0.0025 |

Scraped beef may be served as a liquid or semisolid food A round steak is best utilized for this purpose The pulp should be obtained by scraping the raw meat with a wide knife it should then be rolled into thin patties seared on a hot griddle upon both sides and served piping hot

**Soups and Broths** A *meat stock* is best prepared by using any suitable meat and boiling it for a long time the fat is removed by skimming and the meat particles by straining through a wet cloth This stock should form the basis of soups or broth to which may be added cereal barley or rice Well cooked vegetables cut into small pieces may also be used to thicken the stock

**Eggs** Eggs play an important part in any dietary They should always be fresh and should be cooked at as low a temperature as possible in order to keep them from becoming tough For soft boiling the egg should be placed in boiling water for three to five minutes or the vessel containing the boiling water may be immediately removed from the stove and the egg permitted to remain therein ten minutes To be hard boiled the egg should be placed in warm water which is gradually brought to a boil and then kept at boiling temperature for about ten minutes

**Beverages** The usual beverages served in the sickroom consist of lemonade orangeade grape juice tomato juice and ginger ale A combination of flavors gives a more pleasing taste and it is advisable to prepare such a mixture when the aim is to please the palate For in

stance a little lemon juice pineapple juice or grape juice added to orangeade improves the flavor

Drinks given for the purpose of materially increasing the caloric intake should consist largely of milk milk and cream mixtures or milk and egg preparations A milk shake should be made of rich milk and either whole egg or egg albumin it should be flavored with vanilla cinnamon or any extract of choice and sweetened to taste

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**Table 134. Desirable Weights for Adults***
Ages 25 and Over

| Height (with shoes) | | Women: Weight in Pounds (as Ordinarily Dressed) | | | Men: Weight in Pounds (as Ordinarily Dressed) | | |
|---|---|---|---|---|---|---|---|
| Feet | Inches | Small Frame | Medium Frame | Large Frame | Small Frame | Medium Frame | Large Frame |
| 5 | 0 | 105–113 | 112–120 | 119–129 | | | |
| 5 | 1 | 107–115 | 114–122 | 121–131 | | | |
| 5 | 2 | 110–118 | 117–125 | 124–135 | 116–125 | 124–133 | 131–142 |
| 5 | 3 | 113–121 | 120–128 | 127–138 | 119–128 | 127–136 | 133–144 |
| 5 | 4 | 116–125 | 124–132 | 131–142 | 122–132 | 130–140 | 137–149 |
| 5 | 5 | 119–128 | 127–135 | 133–145 | 126–136 | 134–144 | 141–153 |
| 5 | 6 | 123–132 | 130–140 | 138–150 | 129–139 | 137–147 | 145–157 |
| 5 | 7 | 126–136 | 134–144 | 142–154 | 133–143 | 141–151 | 149–162 |
| 5 | 8 | 129–139 | 137–147 | 145–158 | 136–147 | 145–156 | 153–166 |
| 5 | 9 | 133–143 | 141–151 | 149–162 | 140–151 | 149–160 | 157–170 |
| 5 | 10 | 136–147 | 145–155 | 152–166 | 144–155 | 153–164 | 161–175 |
| 5 | 11 | 139–150 | 148–158 | 155–169 | 148–159 | 157–168 | 165–180 |
| 6 | 0 | 141–153 | 151–163 | 160–174 | 152–164 | 161–173 | 169–185 |
| 6 | 1 | | | | 157–169 | 166–178 | 174–190 |
| 6 | 2 | | | | 163–175 | 171–184 | 179–196 |
| 6 | 3 | | | | 168–180 | 176–189 | 184–202 |

* Statistical Bulletin of the Metropolitan Life Insurance Co, *23* 8 1942, *24* 7 1943

**Table 135. Graded Average Weight in Pounds of Men of Different Statures at Various Ages***

| Age, Years | n | 1 Inch n. | 2 Inches n. | 3 Inches n. | 4 Inches | 5 Inches | 5 Inches | Inches | Inches | Inches | 0 Inches | 1 Inches | | Inch | Inches | Inches | nches | nches |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 107 | 109 | 112 | 115 | 118 | 122 | 126 | 130 | 134 | 138 | 142 | 147 | 152 | 157 | 162 | 167 | 172 | 177 |
| 16 | 109 | 111 | 114 | 117 | 120 | 124 | 128 | 132 | 136 | 140 | 144 | 149 | 154 | 159 | 164 | 169 | 174 | 179 |
| 17 | 111 | 113 | 116 | 119 | 122 | 126 | 130 | 134 | 138 | 142 | 146 | 151 | 156 | 161 | 166 | 171 | 176 | 181 |
| 18 | 113 | 115 | 118 | 121 | 124 | 128 | 132 | 136 | 140 | 144 | 148 | 153 | 158 | 163 | 168 | 173 | 178 | 183 |
| 19 | 115 | 117 | 120 | 123 | 126 | 130 | 134 | 138 | 142 | 146 | 150 | 155 | 160 | 165 | 170 | 175 | 180 | 185 |
| 20 | 117 | 119 | 122 | 125 | 128 | 132 | 136 | 140 | 144 | 148 | 152 | 156 | 161 | 166 | 171 | 176 | 181 | 186 |
| 21 | 118 | 120 | 123 | 126 | 130 | 134 | 138 | 141 | 145 | 149 | 153 | 157 | 162 | 167 | 172 | 177 | 182 | 187 |
| 22 | 119 | 121 | 124 | 127 | 131 | 135 | 139 | 142 | 146 | 150 | 154 | 158 | 163 | 168 | 173 | 178 | 183 | 188 |
| 23 | 120 | 122 | 125 | 128 | 132 | 136 | 140 | 143 | 147 | 151 | 155 | 159 | 164 | 169 | 175 | 180 | 185 | 190 |
| 24 | 121 | 123 | 126 | 129 | 133 | 137 | 141 | 144 | 148 | 152 | 156 | 160 | 165 | 171 | 177 | 182 | 187 | 192 |
| 25 | 122 | 124 | 126 | 129 | 133 | 137 | 141 | 145 | 149 | 153 | 157 | 162 | 167 | 173 | 179 | 184 | 189 | 194 |
| 26 | 123 | 125 | 127 | 130 | 134 | 138 | 142 | 146 | 150 | 154 | 158 | 163 | 168 | 174 | 180 | 186 | 191 | 196 |
| 27 | 124 | 126 | 128 | 131 | 134 | 138 | 142 | 146 | 150 | 154 | 158 | 163 | 169 | 175 | 181 | 187 | 192 | 197 |
| 28 | 125 | 127 | 129 | 132 | 135 | 139 | 143 | 147 | 151 | 155 | 159 | 164 | 170 | 176 | 182 | 188 | 193 | 198 |
| 29 | 126 | 128 | 130 | 133 | 136 | 140 | 144 | 148 | 152 | 156 | 160 | 165 | 171 | 177 | 183 | 189 | 194 | 199 |
| 30 | 126 | 128 | 130 | 133 | 136 | 140 | 144 | 148 | 152 | 156 | 161 | 166 | 172 | 178 | 184 | 190 | 196 | 201 |
| 31 | 127 | 129 | 131 | 134 | 137 | 141 | 145 | 149 | 153 | 157 | 162 | 167 | 173 | 179 | 185 | 191 | 197 | 202 |
| 32 | 127 | 129 | 131 | 134 | 137 | 141 | 145 | 149 | 154 | 158 | 163 | 168 | 174 | 180 | 186 | 192 | 198 | 203 |
| 33 | 127 | 129 | 131 | 134 | 137 | 141 | 145 | 149 | 154 | 159 | 164 | 169 | 175 | 181 | 187 | 193 | 199 | 204 |
| 34 | 128 | 130 | 132 | 135 | 138 | 142 | 146 | 150 | 155 | 160 | 165 | 170 | 176 | 182 | 188 | 194 | 200 | 206 |
| 35 | 128 | 130 | 132 | 135 | 138 | 142 | 146 | 150 | 155 | 160 | 165 | 170 | 176 | 182 | 189 | 195 | 201 | 207 |
| 36 | 129 | 131 | 133 | 136 | 139 | 143 | 147 | 151 | 156 | 161 | 166 | 171 | 177 | 183 | 190 | 196 | 202 | 208 |
| 37 | 129 | 131 | 133 | 136 | 140 | 144 | 148 | 152 | 157 | 162 | 167 | 172 | 178 | 184 | 191 | 197 | 203 | 209 |
| 38 | 130 | 132 | 134 | 137 | 140 | 144 | 148 | 152 | 157 | 162 | 167 | 173 | 179 | 185 | 192 | 198 | 204 | 210 |
| 39 | 130 | 132 | 134 | 137 | 140 | 144 | 148 | 152 | 157 | 162 | 167 | 173 | 179 | 185 | 192 | 199 | 205 | 211 |
| 40 | 131 | 133 | 135 | 138 | 141 | 145 | 149 | 153 | 158 | 163 | 168 | 174 | 180 | 186 | 193 | 200 | 206 | 212 |
| 41 | 131 | 133 | 135 | 138 | 141 | 145 | 149 | 153 | 158 | 163 | 168 | 174 | 180 | 186 | 193 | 200 | 207 | 213 |
| 42 | 132 | 134 | 136 | 139 | 142 | 146 | 150 | 154 | 159 | 164 | 169 | 175 | 181 | 187 | 194 | 201 | 208 | 214 |
| 43 | 132 | 134 | 136 | 139 | 142 | 146 | 150 | 154 | 159 | 164 | 169 | 175 | 181 | 187 | 194 | 201 | 208 | 214 |
| 44 | 133 | 135 | 137 | 140 | 143 | 147 | 151 | 155 | 160 | 165 | 170 | 176 | 182 | 188 | 195 | 202 | 209 | 215 |
| 45 | 133 | 135 | 137 | 140 | 143 | 147 | 151 | 155 | 160 | 165 | 170 | 176 | 182 | 188 | 195 | 202 | 209 | 215 |
| 46 | 134 | 136 | 138 | 141 | 144 | 148 | 152 | 156 | 161 | 166 | 171 | 177 | 183 | 189 | 196 | 203 | 210 | 216 |
| 47 | 134 | 136 | 138 | 141 | 144 | 148 | 152 | 156 | 161 | 166 | 171 | 177 | 183 | 190 | 197 | 204 | 211 | 217 |
| 48 | 134 | 136 | 138 | 141 | 144 | 148 | 152 | 156 | 161 | 166 | 171 | 177 | 183 | 190 | 197 | 204 | 211 | 217 |
| 49 | 134 | 136 | 138 | 141 | 144 | 148 | 152 | 156 | 161 | 166 | 171 | 177 | 183 | 190 | 197 | 204 | 211 | 217 |
| 50 | 134 | 136 | 138 | 141 | 144 | 148 | 152 | 156 | 161 | 166 | 171 | 177 | 183 | 190 | 197 | 204 | 211 | 217 |
| 51 | 135 | 137 | 139 | 142 | 145 | 149 | 153 | 157 | 162 | 167 | 172 | 178 | 184 | 191 | 198 | 205 | 212 | 218 |
| 52 | 135 | 137 | 139 | 142 | 145 | 149 | 153 | 157 | 162 | 167 | 172 | 178 | 184 | 191 | 198 | 205 | 212 | 218 |
| 53 | 135 | 137 | 139 | 142 | 145 | 149 | 153 | 157 | 162 | 167 | 172 | 178 | 184 | 191 | 198 | 205 | 212 | 218 |
| 54 | 135 | 137 | 139 | 142 | 145 | 149 | 153 | 158 | 163 | 168 | 173 | 178 | 184 | 191 | 198 | 205 | 212 | 219 |
| 55 and up | 135 | 137 | 139 | 142 | 145 | 149 | 153 | 158 | 163 | 168 | 173 | 178 | 184 | 191 | 198 | 205 | 212 | 219 |

* Davenport, C. B.: Body Build and Its Inheritance. Publication 329, Carnegie Institute of Washington, 1923.

**Table 136. Graded Average Weight in Pounds of Women of Different Statures at Various Ages***

| Age, Years | Inches | Inches | 0 Inches | 1 Inches | | Inch | Inches | Inches | Inches | Inches | Inches | Inches | Inches | Inches | 0 Inches | 1 Inches | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 101 | 103 | 105 | 106 | 107 | 109 | 112 | 115 | 118 | 122 | 126 | 130 | 134 | 138 | 142 | 147 | 152 |
| 16 | 102 | 104 | 106 | 108 | 109 | 111 | 114 | 117 | 120 | 124 | 128 | 132 | 136 | 139 | 143 | 148 | 153 |
| 17 | 103 | 105 | 107 | 109 | 111 | 113 | 116 | 119 | 122 | 125 | 129 | 133 | 137 | 140 | 144 | 149 | 154 |
| 18 | 104 | 106 | 108 | 110 | 112 | 114 | 117 | 120 | 123 | 126 | 130 | 134 | 138 | 141 | 145 | 150 | 155 |
| 19 | 105 | 107 | 109 | 111 | 113 | 115 | 118 | 121 | 124 | 127 | 131 | 135 | 139 | 142 | 146 | 151 | 155 |
| 20 | 106 | 108 | 110 | 112 | 114 | 116 | 119 | 122 | 125 | 128 | 132 | 136 | 140 | 143 | 147 | 151 | 156 |
| 21 | 107 | 109 | 111 | 113 | 115 | 117 | 120 | 123 | 126 | 129 | 133 | 137 | 141 | 144 | 148 | 152 | 156 |
| 22 | 107 | 109 | 111 | 113 | 115 | 117 | 120 | 123 | 126 | 129 | 133 | 137 | 141 | 145 | 149 | 153 | 157 |
| 23 | 108 | 110 | 112 | 114 | 116 | 118 | 121 | 124 | 127 | 130 | 134 | 138 | 142 | 146 | 150 | 153 | 157 |
| 24 | 109 | 111 | 113 | 115 | 117 | 119 | 121 | 124 | 127 | 130 | 134 | 138 | 142 | 146 | 150 | 154 | 158 |
| 25 | 109 | 111 | 113 | 115 | 117 | 119 | 121 | 124 | 128 | 131 | 135 | 139 | 143 | 147 | 151 | 154 | 158 |
| 26 | 110 | 112 | 114 | 116 | 118 | 120 | 122 | 125 | 128 | 131 | 135 | 139 | 143 | 147 | 151 | 155 | 159 |
| 27 | 110 | 112 | 114 | 116 | 118 | 120 | 122 | 125 | 129 | 132 | 136 | 140 | 144 | 148 | 152 | 155 | 159 |
| 28 | 111 | 113 | 115 | 117 | 119 | 121 | 123 | 126 | 130 | 133 | 137 | 141 | 145 | 149 | 153 | 156 | 160 |
| 29 | 111 | 113 | 115 | 117 | 119 | 121 | 123 | 126 | 130 | 133 | 137 | 141 | 145 | 149 | 153 | 156 | 160 |
| 30 | 112 | 114 | 116 | 118 | 120 | 122 | 124 | 127 | 131 | 134 | 138 | 142 | 146 | 150 | 154 | 157 | 161 |
| 31 | 113 | 115 | 117 | 119 | 121 | 123 | 125 | 128 | 132 | 135 | 139 | 143 | 147 | 151 | 154 | 157 | 161 |
| 32 | 113 | 115 | 117 | 119 | 121 | 123 | 125 | 128 | 132 | 136 | 140 | 144 | 148 | 152 | 155 | 158 | 162 |
| 33 | 114 | 116 | 118 | 120 | 122 | 124 | 126 | 129 | 133 | 137 | 141 | 145 | 149 | 153 | 156 | 159 | 162 |
| 34 | 115 | 117 | 119 | 121 | 123 | 125 | 127 | 130 | 134 | 138 | 142 | 146 | 150 | 154 | 157 | 160 | 163 |
| 35 | 115 | 117 | 119 | 121 | 123 | 125 | 127 | 130 | 134 | 138 | 142 | 146 | 150 | 154 | 157 | 160 | 163 |
| 36 | 116 | 118 | 120 | 122 | 124 | 126 | 128 | 131 | 135 | 139 | 143 | 147 | 151 | 155 | 158 | 161 | 164 |
| 37 | 116 | 118 | 120 | 122 | 124 | 126 | 129 | 132 | 136 | 140 | 144 | 148 | 152 | 156 | 159 | 162 | 165 |
| 38 | 117 | 119 | 121 | 123 | 125 | 127 | 130 | 133 | 137 | 141 | 145 | 149 | 153 | 157 | 160 | 163 | 166 |
| 39 | 118 | 120 | 122 | 124 | 126 | 128 | 131 | 134 | 138 | 142 | 146 | 150 | 154 | 158 | 161 | 164 | 167 |
| 40 | 119 | 121 | 123 | 125 | 127 | 129 | 132 | 135 | 138 | 142 | 146 | 150 | 154 | 158 | 161 | 164 | 167 |
| 41 | 120 | 122 | 124 | 126 | 128 | 130 | 133 | 136 | 139 | 143 | 147 | 151 | 155 | 159 | 162 | 165 | 168 |
| 42 | 120 | 122 | 124 | 126 | 128 | 130 | 133 | 136 | 139 | 143 | 147 | 151 | 155 | 159 | 162 | 166 | 169 |
| 43 | 121 | 123 | 125 | 127 | 129 | 131 | 134 | 137 | 140 | 144 | 148 | 152 | 156 | 160 | 163 | 167 | 170 |
| 44 | 122 | 124 | 126 | 128 | 130 | 132 | 135 | 138 | 141 | 145 | 149 | 153 | 157 | 161 | 164 | 168 | 171 |
| 45 | 122 | 124 | 126 | 128 | 130 | 132 | 135 | 138 | 141 | 145 | 149 | 153 | 157 | 161 | 164 | 168 | 171 |
| 46 | 123 | 125 | 127 | 129 | 131 | 133 | 136 | 139 | 142 | 146 | 150 | 154 | 158 | 162 | 165 | 169 | 172 |
| 47 | 123 | 125 | 127 | 129 | 131 | 133 | 136 | 139 | 142 | 146 | 151 | 155 | 159 | 163 | 166 | 170 | 173 |
| 48 | 124 | 126 | 128 | 130 | 132 | 134 | 137 | 140 | 143 | 147 | 152 | 156 | 160 | 164 | 167 | 171 | 174 |
| 49 | 124 | 126 | 128 | 130 | 132 | 134 | 137 | 140 | 143 | 147 | 152 | 156 | 161 | 165 | 168 | 172 | 175 |
| 50 | 125 | 127 | 129 | 131 | 133 | 135 | 138 | 141 | 144 | 148 | 152 | 156 | 161 | 165 | 169 | 173 | 176 |
| 51 | 125 | 127 | 129 | 131 | 133 | 135 | 138 | 141 | 144 | 148 | 152 | 157 | 162 | 166 | 170 | 174 | 177 |
| 52 | 125 | 127 | 129 | 131 | 133 | 135 | 138 | 141 | 144 | 148 | 152 | 157 | 162 | 166 | 170 | 174 | 177 |
| 53 | 125 | 127 | 129 | 131 | 133 | 135 | 138 | 141 | 144 | 148 | 152 | 157 | 162 | 166 | 170 | 174 | 177 |
| 54 | 125 | 127 | 129 | 131 | 133 | 135 | 138 | 141 | 144 | 148 | 153 | 158 | 163 | 167 | 171 | 174 | 177 |
| 55 | 125 | 127 | 129 | 131 | 133 | 135 | 138 | 141 | 144 | 148 | 153 | 158 | 163 | 167 | 171 | 174 | 177 |

* Davenport, C. B.; Body Build and Its Inheritance. Publication 329, Carnegie Institute of Washington, 1923.

Table 137 Canadian Dietary Standard, 1948*

Girls

| Body Weight* (Lbs. with Approximate Equivalent age in Brackets) | Calories | Protein (Gm.) | Calcium† (Gm.) | Iron (Mg.) | Vitamin A‡ (as Carotene) (International Units) | Thiamine (Mg.) | Riboflavin (Mg.) | Niacin (Mg.) | Ascorbic Acid (C) (Mg.) | Vitamin D (International Units) |
|---|---|---|---|---|---|---|---|---|---|---|
| 20 (1) | 1050 | 35 | 1.0 | 6 | 700 | 0.30 | 0.50 | 3.0 | 30 | 400–800 |
| 30 (3) | 1300 | 37 | 1.0 | 6 | 1000 | 0.40 | 0.65 | 4.0 | 30 | 400 |
| 40 (5) | 1600 | 40 | 1.0 | 6 | 1300 | 0.50 | 0.80 | 5.0 | 30 | 400 |
| 50 (7) | 1800 | 45 | 1.0 | 6 | 1600 | 0.55 | 0.90 | 5.5 | 30 | 400 |
| 60 (9) | 2100 | 50 | 1.0 | 6 | 2000 | 0.65 | 1.10 | 6.5 | 30 | 400 |
| 70 (10) | 2300 | 55 | 1.0 | 6 | 2300 | 0.70 | 1.15 | 7.0 | 30 | 400 |
| 80 (11) | 2450 | 60 | 1.0 | 6 | 2600 | 0.75 | 1.25 | 7.5 | 30 | 400 |
| 90 (12) | 2475 | 70 | 1.5 | 6 | 3000 | 0.75 | 1.25 | 7.5 | 30 | 400 |
| 100 (14)§ | 2500 | 75 | 1.5 | 12 | 3300 | 0.75 | 1.25 | 7.5 | 30 | 400 |

Boys

| Body Weight* (Lbs. with Approximate Equivalent age in Brackets) | Calories | Protein (Gm.) | Calcium† (Gm.) | Iron (Mg.) | Vitamin A‡ (as Carotene) (International Units) | Thiamine (Mg.) | Riboflavin (Mg.) | Niacin (Mg.) | Ascorbic Acid (C) (Mg.) | Vitamin D (International Units) |
|---|---|---|---|---|---|---|---|---|---|---|
| 20 (1) | 1050 | 35 | 1.0 | 6 | 700 | 0.30 | 0.50 | 3.0 | 30 | 400–800 |
| 30 (3) | 1300 | 37 | 1.0 | 6 | 1000 | 0.40 | 0.65 | 4.0 | 30 | 400 |
| 40 (5) | 1600 | 40 | 1.0 | 6 | 1300 | 0.50 | 0.80 | 5.0 | 30 | 400 |
| 50 (7) | 1850 | 45 | 1.0 | 6 | 1600 | 0.55 | 0.90 | 5.5 | 30 | 400 |
| 60 (9) | 2180 | 50 | 1.0 | 6 | 2000 | 0.65 | 1.10 | 6.5 | 30 | 400 |
| 70 (10) | 2300 | 55 | 1.0 | 6 | 2300 | 0.70 | 1.15 | 7.0 | 30 | 400 |
| 80 (12) | 2500 | 60 | 1.0 | 6 | 2600 | 0.75 | 1.25 | 7.5 | 30 | 400 |
| 90 (13) | 2650 | 65 | 1.5 | 12 | 3000 | 0.80 | 1.30 | 8.0 | 30 | 400 |
| 100 (14) | 2850 | 70 | 1.5 | 12 | 3300 | 0.85 | 1.40 | 8.5 | 30 | 400 |
| 110 (15)§ | 3000 | 80 | 1.5 | 12 | 3600 | 0.90 | 1.50 | 9.0 | 30 | 400 |

* Canadian Council on Nutrition Canadian Bulletin on Nutrition 2 31 1950

Table 157 Canadian Dietary Standard, 1948—(Continued)

(The Figures give the maintenance allowances for the body weights shown plus additional needs for activity as indicated)

*Men*

| Body Weight* (Lbs.) | Degree of Activity | Calories | Protein (Gm.) | Calcium† (Gm.) | Iron (Mg.) | Vitamin A‡ (as Carotene) (International Units) | Thiamine (Mg.) | Riboflavin (Mg.) | Niacin (Mg.) | Ascorbic Acid (C) (Mg.) |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sedentary | 1625 | 40 | 0.40 | 6 | 2600 | 0.45 | 0.8 | 4.5 | 30 |
| 80 | Moderate | 2150 | 40 | 0.40 | 6 | 2600 | 0.60 | 1.1 | 6.0 | 30 |
| | Heavy | 2900 | 40 | 0.40 | 6 | 2600 | 0.85 | 1.4 | 8.5 | 30 |
| | Very heavy | 3900 | 40 | 0.40 | 6 | 2600 | 1.15 | 1.9 | 11.5 | 30 |
| | Sedentary | 1825 | 50 | 0.45 | 6 | 3200 | 0.55 | 0.9 | 5.5 | 30 |
| 100 | Moderate | 2350 | 50 | 0.45 | 6 | 3200 | 0.70 | 1.2 | 7.0 | 30 |
| | Heavy | 3100 | 50 | 0.45 | 6 | 3200 | 0.95 | 1.5 | 9.5 | 30 |
| | Very heavy | 4100 | 50 | 0.45 | 6 | 3200 | 1.25 | 2.0 | 12.5 | 30 |
| | Sedentary | 2125 | 55 | 0.55 | 6 | 4000 | 0.65 | 1.0 | 6.5 | 30 |
| 120 | Moderate | 2650 | 55 | 0.55 | 6 | 4000 | 0.80 | 1.3 | 8.0 | 30 |
| | Heavy | 3400 | 55 | 0.55 | 6 | 4000 | 1.05 | 1.6 | 10.5 | 30 |
| | Very heavy | 4400 | 55 | 0.55 | 6 | 4000 | 1.35 | 2.1 | 13.5 | 30 |
| | Sedentary | 2325 | 60 | 0.65 | 6 | 4600 | 0.70 | 1.1 | 7.0 | 30 |
| 140 | Moderate | 2850 | 60 | 0.65 | 6 | 4600 | 0.85 | 1.4 | 8.5 | 30 |
| | Heavy | 3600 | 60 | 0.65 | 6 | 4600 | 1.10 | 1.7 | 11.0 | 30 |
| | Very heavy | 4600 | 60 | 0.65 | 6 | 4600 | 1.40 | 2.2 | 14.0 | 30 |
| | Sedentary | 2525 | 70 | 0.75 | 6 | 5300 | 0.75 | 1.2 | 7.5 | 30 |
| 160 | Moderate | 3050 | 70 | 0.75 | 6 | 5300 | 0.90 | 1.5 | 9.0 | 30 |
| | Heavy | 3800 | 70 | 0.75 | 6 | 5300 | 1.15 | 1.8 | 11.5 | 30 |
| | Very heavy | 4800 | 70 | 0.75 | 6 | 5300 | 1.45 | 2.3 | 14.5 | 30 |
| | Sedentary | 2725 | 75 | 0.80 | 6 | 5900 | 0.80 | 1.3 | 8.0 | 30 |
| 180 | Moderate | 3250 | 75 | 0.80 | 6 | 5900 | 0.95 | 1.6 | 9.5 | 30 |
| | Heavy | 4000 | 75 | 0.80 | 6 | 5900 | 1.20 | 1.9 | 12.0 | 30 |
| | Very heavy | 5000 | 75 | 0.80 | 6 | 5900 | 1.50 | 2.4 | 15.0 | 30 |
| | Sedentary | 2925 | 80 | 0.90 | 6 | 6600 | 0.85 | 1.4 | 8.5 | 30 |
| 200 | Moderate | 3450 | 80 | 0.90 | 6 | 6600 | 1.00 | 1.7 | 10.0 | 30 |
| | Heavy | 4200 | 80 | 0.90 | 6 | 6600 | 1.25 | 2.0 | 12.5 | 30 |
| | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 2.5 | 15.5 | 30 |

**Table 137 Canadian Dietary Standard, 1948—(Continued)**

Women

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sedentary | 1625 | 40 | 0.40 | 12 | 2600 | 0.45 | 0.8 | 4.5 | 30 |
| 80 | Moderate | 1900 | 40 | 0.40 | 12 | 2600 | 0.55 | 0.9 | 5.5 | 30 |
| | Heavy | 2400 | 40 | 0.40 | 12 | 2600 | 0.70 | 1.2 | 7.0 | 30 |
| | Sedentary | 1825 | 50 | 0.45 | 12 | 3200 | 0.55 | 0.9 | 5.5 | 30 |
| 100 | Moderate | 2100 | 50 | 0.45 | 12 | 3200 | 0.65 | 1.0 | 6.5 | 30 |
| | Heavy | 2600 | 50 | 0.45 | 12 | 3200 | 0.80 | 1.3 | 8.0 | 30 |
| | Sedentary | 2125 | 55 | 0.55 | 12 | 4000 | 0.65 | 1.0 | 6.5 | 30 |
| 120 | Moderate | 2400 | 55 | 0.55 | 12 | 4000 | 0.75 | 1.1 | 7.5 | 30 |
| | Heavy | 2900 | 55 | 0.55 | 12 | 4000 | 0.90 | 1.4 | 9.0 | 30 |
| | Sedentary | 2325 | 60 | 0.65 | 12 | 4600 | 0.70 | 1.1 | 7.0 | 30 |
| 140 | Moderate | 2600 | 60 | 0.65 | 12 | 4600 | 0.80 | 1.2 | 8.0 | 30 |
| | Heavy | 3100 | 60 | 0.65 | 12 | 4600 | 0.95 | 1.5 | 9.5 | 30 |
| | Sedentary | 2525 | 70 | 0.75 | 12 | 5300 | 0.75 | 1.2 | 7.5 | 30 |
| 160 | Moderate | 2800 | 70 | 0.75 | 12 | 5300 | 0.85 | 1.3 | 8.5 | 30 |
| | Heavy | 3300 | 70 | 0.75 | 12 | 5300 | 1.00 | 1.6 | 10.0 | 30 |
| In Pregnancy‖ (latter half) add to the maintenance plus work | | up to 500 | 25 | 1.0 | 3 | 2000 | 15 | 0.2 | 1.5 | — |
| In Lactation‖ add to the maintenance plus work | | up to 1000 | 25 | 1.0 | 3 | 2000 | 30 | 0.5 | 3.0 | — |

* Body weight or size is probably the most important cause of variations in nutrient requirements but it is recognized that other factors also operate and that not all of the nutrients listed have been shown to vary with body size

† Calcium—*use these values for phosphorus also*

‡ Vitamin A given in terms of carotene one quarter of these amounts may be used if taken as preformed vitamin A

‖ Vitamin D—400 I U are required

§ For children heavier than these weights use adult standards plus an allowance for activity

**Table 138 Caloric Values of Alcoholic Beverages***

| Beverage | Portion | Quantity | Alcohol (Per cent by Weight) | Total Extracts (Per cent) | Total Fuel Value (Calories) | Calories per 100 (Gm) |
|---|---|---|---|---|---|---|
| Distilled Liquors | | | | | | |
| Brandy, California | Cordial glass | 20 cc | 45 80 | 0 45 | 65 | 325 |
| Brandy, cherry | Cordial glass | 20 cc | 44 00 | 0 01 | 62 | 310 |
| Brandy, cognac, pure French | Cordial glass | 20 cc | 55 90 | 0 02 | 78 | 390 |
| Cocktail, Dry Martini | Cocktail glass | 75 cc | 21 30 | 6 21 | 131 | 175 |
| Gin | | 50 cc | 30 00 | 5 50 | 116 | 232 |
| Liqueurs | | | | | | |
| Benedictine | Cordial glass | 20 cc | 42 40 | 35 00 | 88 | 440 |
| Chartreuse | Cordial glass | 20 cc | 35 20 | 35 40 | 78 | 390 |
| Curacao | Cordial glass | 20 cc | 42 00 | 27 90 | 82 | 410 |
| Creme de Menthe | Cordial glass | 20 cc | 36 50 | 28 28 | 74 | 370 |
| Kummel | Cordial glass | 20 cc | 26 00 | 29 80 | 61 | 305 |
| Rum | | 50 cc | 43 50 | 0 13 | 153 | 306 |
| Rum, pure Jamaica | | 50 cc | 69 61 | 0 61 | 245 | 490 |
| Whiskey, American, genuine | | 50 cc | 43 00 | 0 70 | 152 | 304 |
| Whiskey, European | | 50 cc | 39 00 | | 137 | 274 |
| Wines and Ciders | | | | | | |
| American Wines | | | | | | |
| California, red | Claret glass | 120 cc | 9 50 | 3 10 | 95 | 79 |
| California, white | Claret glass | 120 cc | 9 00 | 2 70 | 89 | 74 |
| Sweet wines | | | | | | |
| Catawba | Sherry glass | 30 cc | 11 07 | 5 60 | 30 | 100 |
| Champagne | Champagne glass | 135 cc | 8 27 | 9 74 | 132 | 98 |
| Port, California | Sherry glass | 30 cc | 14 81 | 12 17 | 53 | 176 |
| Sherry, California | Sherry glass | 30 cc | 14 67 | 5 53 | 38 | 126 |

Table 138 Caloric Values of *Alcoholic Beverages*—(Continued)

| Beverage | Portion | Quantity | Alcohol (Per cent by Weight) | Total Extracts (Per cent) | Total Fuel Value (Calories) | Calories per 100 (Gm ) |
|---|---|---|---|---|---|---|
| Wines and Ciders—Continued | | | | | | |
| European Wines | | | | | | |
| Champagne, dry | Champagne glass | 135 cc | 10 42 | 2 36 | 112 | 83 |
| French, red (claret) | Claret glass | 120 cc | 8 16 | 2 42 | 81 | 67 |
| French, white | Claret glass | 120 cc | 9 48 | 3 03 | 95 | 79 |
| Mosel and Saar, white | Claret glass | 120 cc | 7 36 | 2 31 | 73 | 61 |
| Rhein, white | Claret glass | 120 cc | 8 12 | 2 91 | 83 | 69 |
| Sweet wines | | | | | | |
| Champagne | Champagne glass | 135 cc | 9 50 | 12 88 | 161 | 119 |
| Madeira | Sherry glass | 30 cc | 15 40 | 5 52 | 39 | 130 |
| Malaga | Sherry glass | 30 cc. | 11 93 | 21 73 | 52 | 173 |
| Marsala | Sherry glass | 30 cc | 15 85 | 5 28 | 40 | 133 |
| Port | Sherry glass | 30 cc | 16 69 | 8 05 | 45 | 150 |
| Sherry | Sherry glass | 30 cc | 17 45 | 3 98 | 42 | 140 |
| Tokay, fresh | Sherry glass | 30 cc | 11 19 | 12 72 | 39 | 130 |
| Ciders | | | | | | |
| American, sweet | Glass | 250 cc | 1 40 | 8 20 | 109 | 44 |
| American, fermented | Glass | 250 cc | 5 17 | 3 88 | 130 | 52 |
| Malt Liquors | | | | | | |
| American | | | | | | |
| Ale | Glass | 250 cc. | 6 02 | 4 86 | 155 | 62 |
| Lager beer, bottled | Glass | 250 cc | 4 53 | 4 96 | 130 | 52 |
| Lager beer, draft | Glass | 250 cc | 4 27 | 4 40 | 120 | 48 |
| Porter | Glass | 250 cc. | 4 46 | 6 00 | 140 | 56 |

| | | | | | | |
|---|---|---|---|---|---|---|
| European | | | | | | |
| Ale | Glass | 250 cc | 5 27 | 5 99 | 154 | 62 |
| Bock beer | Glass | 250 cc | 4 20 | 7 10 | 146 | 58 |
| Export beer | Glass | 250 cc | 4 29 | 6 50 | 142 | 57 |
| Light beer | Glass | 250 cc | 3 69 | 5 39 | 120 | 48 |
| Munich, heavy beer | Glass | 250 cc | 4 54 | 9 96 | 182 | 73 |
| Pilsen, export beer | Glass | 250 cc | 4 28 | 4 69 | 123 | 49 |
| Porter (Stout) | Glass | 250 cc. | 5 16 | 7 97 | 172 | 69 |
| Weissbeer | Glass | 250 cc. | 2 79 | 5 29 | 103 | 41 |

* The enormous variation in the composition of *alcoholic liquors* has made it exceedingly difficult to choose values which should be accurate and comparable As a rule the percentages given are averages of a large number of analyses and if not strictly accurate are as nearly so as it is possible to obtain them

The total extractives are reckoned as sugar notwithstanding the fact that they comprise other substances than *carbohydrates in small amounts* which cannot be classified as foods The percentage of these however is so small that the error is negligible

*Alcohol* is computed *solely on the basis of its function* as a food In more than moderate quantities it acts as a drug instead and when taken to excess this action may negative entirely its action as a food or even interfere with the digestion and absorption of other foods

(From Locke E A Food Values. New York Appleton & Co Published here through the courtesy of the author)

## Table 139 Table of Equivalents

| | | | |
|---|---|---|---|
| 1 kilogram | = | 2 2 | pounds |
| 1 *pound* | = | 453 6 | *grams* |
| 1 ounce | = | 28 3 | grams |
| 1 liter | = | 1 057 | quarts |
| 1 gram calory | = | 0 425 | kilogram meter of mechanical energy |
| 1 meter | = | 3 28 | feet |
| 1 kilometer | = | 0 6214 | mile |
| 1 sq meter | = | 10 764 | sq feet |
| *1 fl ounce* | = | *30* | *cc (approx)* |

| | | | |
|---|---|---|---|
| 1 teaspoon | Fluid | = | 5 cc or 1/6 fluid ounce |
| 1 *tablespoon* | *Fluid* | = | *15 cc. or ½ fluid ounce* |
| 1 ordinary cup | Fluid | = | 250 cc. or 8 fluid ounces |
| 1 tumbler or glass | Fluid | = | 250 cc or 8 fluid ounces |
| 1 *cordial* glass | Fluid | = | 20 cc. or ⅔ fluid ounce |
| 1 sherry glass | Fluid | = | 30 cc. or 1 fluid ounce |
| 1 cocktail glass | Fluid | = | 75 cc. or 2½ fluid ounces |
| 1 claret glass | Fluid | = | 120 cc. or 4 fluid ounces |
| 1 champagne glass | Fluid | = | 135 cc or 4½ fluid ounces |

**Table 140** *Sodium and Potassium Content of Foods Analyses Made on Edible Portions of Unprocessed Foods Except as Otherwise Designated**

| Food | Sodium (mg / 100 gm ) | Potassium (mg / 100 gm ) |
|---|---|---|
| All Bran cereal | 1400 | 1200 |
| *Allspice* | *62* | *680* |
| Almond | | |
| *Raw* | *3* | *690* |
| Roasted in oil salted | 160 | 710 |
| Anchovy paste | 9800 | 200 |
| Apples | | |
| *Juice (sweet cider)* | | |
| bottled | 4 | 100 |
| June less skin and core | 0 1 | 71 |
| Mackintosh | | |
| *less skin and core* | *0.2* | *90* |
| Red Delicious | | |
| less skin and core | 0 3 | 76 |
| Sauce canned | 0 3 | 55 |
| *Apricot* | | |
| Canned in sirup | 2 | 65 |
| Dried | 11 | 1700 |
| Raw with skin | 0 6 | 440 |
| *Artichoke globe* | *43* | *430* |
| *Asparagus* | | |
| Spears canned | 410 | 130 |
| Tips fresh | 2 | 240 |
| Tips *frozen* | *3* | *320* |
| Avocado | 3 | 340 |
| Bacon | | |
| Fried crisp | 2400 | 390 |
| Raw | 680 | 110 |
| Baking powder | | |
| Alum type | 10 000 | 150 |
| Phosphate type | 9000 | 170 |
| Tartrate type | 7300 | 5000 |
| Banana | 0 5 | 420 |
| Barley pearled | 3 | 160 |
| Beans | | |
| Baked Heinz Navy | | |
| With pork and | | |
| *tomato sauce* | | |
| canned | 480 | 210 |
| With tomato sauce | | |
| canned | 400 | 140 |
| Dry Navy | 1 | 1300 |
| Green in pods | | |
| Canned | 410 | 120 |
| Fresh | 0 9 | 300 |
| Frozen | 2 | 110 |
| Lima | | |
| Canned | 310 | 210 |
| Fresh | *1* | *680* |
| Frozen | 310 | 580 |
| Beef | | |
| Corned | 1300 | 60 |
| Dried | *4300* | *200* |
| Lean koshered raw | 1600 | 290 |
| Lean raw | 51 | 360 |

| Food | Sodium (mg / 100 gm ) | Potassium (mg / 100 gm ) |
|---|---|---|
| Beer | 8 | 46 |
| *Beets* | | |
| Canned | 36 | 120 |
| *Greens fresh* | *130* | *570* |
| Raw | 110 | 350 |
| Blackberry | 0.2 | 150 |
| Blueberry | 0 6 | 89 |
| *Bouillon cube* | *24 000* | *100* |
| Brain pig | 150 | 340 |
| Bran wheat crude | 15 | 980 |
| Brandy | 3 | 4 |
| *Brazil nuts* | | |
| Raw | 1 | 670 |
| Roasted in oil salted | 190 | 730 |
| Bread | | |
| *Boston brown* | | |
| with raisins | 280 | 360 |
| Low sodium— | | |
| 4 laboratory samples | 3 | 94 |
| Low sodium cinnamon | | |
| roll—laboratory | | |
| sample | 2 | 120 |
| Low sodium—14 com | | |
| mercial salt free | | |
| breads | | |
| Maximum | 76 | 200 |
| Minimum | 4 | 72 |
| Average | 28 | 120 |
| Passover—See matzoth | | |
| Rye and wheat | 590 | 160 |
| White enriched | 640 | 180 |
| Whole wheat | 930 | 230 |
| Whole wheat and | | |
| white | 620 | 250 |
| Breakfast cereals— | | |
| See individual cereal | | |
| Broccoli | | |
| Fresh | 16 | 400 |
| Frozen | 13 | 250 |
| Brussels sprouts | | |
| Fresh | *11* | *450* |
| Frozen | 9 | 300 |
| Butter | | |
| Theoretical sodium | | |
| *value based on U S* | | |
| average salt content | | |
| *of 2 5%* | 980 | |
| 4 Indiana samples | 880 | 23 |
| *Unsalted* | 5 | 4 |
| Buttermilk cultured | 130 | 140 |
| Cabbage | 5 | 230 |
| Candy | | |
| Bar Baby Ruth | 170 | 300 |
| Bar Milky Way | 220 | 150 |
| Bar Oh Henry | 76 | 420 |

* Bills C E and others J Am Dietet A *25* 304 1949

Table 140 (Continued)

| Food | Sodium (mg / 100 gm) | Potassium (mg / 100 gm) |
|---|---|---|
| Gum drop | 41 | 18 |
| Marshmallow | 41 | 6 |
| Milk chocolate | 86 | 420 |
| Necco Wafers | 5 | 2 |
| Peppermint patty Schrafft s | 10 | 110 |
| Sweet chocolate | 35 | 230 |
| Cantaloupe | 12 | 230 |
| Caraway seed | 17 | 1400 |
| Carbonated drinks—See individual drinks | | |
| Carrots | | |
| Canned | 280 | 110 |
| Scraped and trimmed | 31 | 410 |
| Casein | | |
| Acid washed | 0 4 | 2 |
| Low ash commercial | 13 | 39 |
| Vitamin free | 160 | 900 |
| Cashew nuts | | |
| Raw | 14 | 560 |
| Roasted in oil salted | 200 | 560 |
| Catchup tomato | 1300 | 600 |
| Catfish (fiddler) | | |
| Ohio River | 60 | 330 |
| Cauliflower | | |
| Buds | 24 | 400 |
| Buds frozen | 22 | 290 |
| Caviar salmon canned | 2200 | 180 |
| Celery | | |
| Salt | 28 000 | 380 |
| Seed | 140 | 1400 |
| Stalks less leaves | 110 | 300 |
| Cereals dry | | |
| Bran | | |
| All Bran | 1400 | 1200 |
| Crude unsalted | 15 | 980 |
| Corn flakes | 660 | 160 |
| Farina | | |
| Cream of Wheat plain | 2 | 86 |
| Cream of Wheat quick cooking enriched | 90 | 84 |
| Grape Nuts | 660 | 230 |
| Pabena | 640 | 340 |
| Pablum | 620 | 380 |
| Rolled oats | 2 | 340 |
| Ry Krisp | 1500 | 600 |
| Wheat | | |
| Flakes | 1300 | 320 |
| Germ malt flavored Zing | 9 | 780 |
| Instant Ralston | 1 | 360 |
| Maltex | 4 | 250 |
| Muffets | 4 | 300 |
| Pettijohn s | 2 | 380 |
| Puffed | 4 | 340 |
| Shredded | 2 | 330 |
| Wheatena | 2 | 380 |
| Certo (pectin solution) | 15 | 110 |
| Chard | | |
| Large leaves | 210 | 720 |
| Small leaves | 84 | 380 |
| Cheese | | |
| American Swiss | 710 | 100 |
| Cheddar | 700 | 92 |
| Cottage | 290 | 72 |
| Cream Philadelphia | 250 | 74 |
| Process | 1500 | 80 |
| Whey Velveeta | 1600 | 270 |
| Cherries | | |
| Sour frozen in sirup | 2 | 78 |
| Sweet | | |
| Dark | | |
| Raw | 1 | 260 |
| Canned in sirup | 0 8 | 77 |
| Frozen in sirup | 1 | 280 |
| Light, canned in sirup | 3 | 55 |
| Chestnut | 2 | 410 |
| Chicken raw | | |
| Breast meat | 78 | 320 |
| Leg meat | 110 | 250 |
| Chocolate—See also individual candy | | |
| Sirup Hershey | 60 | 130 |
| Unsweetened | 4 | 830 |
| Cider sweet (apple juice) bottled | 4 | 100 |
| Cinnamon | 8 | 200 |
| Citron candied | 290 | 120 |
| Clam | 180 | 240 |
| Clove | 210 | 1000 |
| Coca Cola | 1 | 52 |
| Cocoa | | |
| Dutch process | 57 | 3200 |
| Plain Hershey | 5 | 1400 |
| Coconut | | |
| Dry shredded | 16 | 770 |
| Meat | 29 | 320 |
| Milk | 53 | 190 |
| Cod | | |
| Raw | 60 | 360 |
| Frozen fillets | 400 | 400 |
| liver oil | 0 1 | 0 |
| Salted dried | 8100 | 160 |
| Coffee | | |
| Instant Nescafé dry | 84 | 3100 |
| Roasted | | |
| Decaffeinated Sanka dry | 6 | 2000 |
| Regular dry | 2 | 1600 |

Table 140 (Continued)

| Food | Sodium (mg / 100 gm ) | Potassium (mg / 100 gm ) |
|---|---|---|
| Cookie salt free | | |
| Betty Bakerite | 12 | 240 |
| Corn | | |
| Flakes | 660 | 160 |
| Meal yellow enriched degerminated | 0.7 | 120 |
| Oil | 0.2 | 0.1 |
| Popcorn popped and oiled | 3 | 210 |
| Popcorn popped oiled and salted | 2000 | 210 |
| Starch | 4 | 4 |
| Sweet | | |
| White | | |
| Canned | 200 | 200 |
| Milk stage | 0.3 | 240 |
| Yellow | | |
| Canned | 210 | 200 |
| Frozen | 9 | 190 |
| Milk stage | 0.4 | 370 |
| Yellow field dry—5 varieties | 0.6 | 290 |
| Cowpeas fresh shelled | 2 | 560 |
| Crab canned | 1000 | 110 |
| Crackers | | |
| Graham | 710 | 330 |
| Rye Ry Krisp | 1500 | 600 |
| Soda | 1100 | 120 |
| Unsalted Jewish—See matzoth | | |
| Cranberry | | |
| Raw | 1 | 65 |
| Sauce canned | 1 | 17 |
| Cream of tartar—theoretical value for pure $KHC_4H_4O_6$ | 0 | 20776 |
| Cream whipping 32% fat | 40 | 56 |
| Crisco (vegetable shortening) | 4 | 0 |
| Cucumber less parings | 0.9 | 230 |
| Currants | | |
| Red | 2 | 160 |
| Zante dried (Zante raisins) | 22 | 730 |
| Curry powder | 45 | 1300 |
| Dandelion greens | 76 | 430 |
| Date semi dry California | 1 | 790 |
| Dextri Maltose | | |
| No 1 | 840 | 160 |
| No 2 | 46 | 160 |
| No 3 | 46 | 1300 |
| B | 52 | 360 |
| Dextrin | 14 | 14 |
| Dextrose | 1 | 0.4 |
| Dill seed | 13 | 1000 |
| Duck domesticated raw | | |
| Breast meat | 68 | 360 |
| Leg meat | 96 | 210 |
| Egg | | |
| Whites only | 110 | 100 |
| Whole | 81 | 100 |
| Yolks only | 26 | 100 |
| Eggplant less skin | 0.9 | 190 |
| Endive greens | 18 | 400 |
| Fariña | | |
| Cream of Wheat plain dry | 2 | 86 |
| Cream of Wheat, quick cooking enriched dry | 90 | 84 |
| Figs | | |
| Canned in sirup | 1 | 105 |
| Dried | 34 | 780 |
| Raw | 2 | 190 |
| Filberts (hazelnut) | 1 | 560 |
| Flour | | |
| Bleached | | |
| Enriched Gold Medal | 1 | 86 |
| Enriched phosphated | 13 | 78 |
| Buckwheat | 1 | 680 |
| Gluten | 2 | 24 |
| Rye dark | 1 | 860 |
| Self rising | 1500 | 90 |
| Untreated high extraction | 1 | 120 |
| Whole wheat (Graham) | 2 | 290 |
| Fruit cocktail canned in sirup | 9 | 160 |
| Garlic less skin | 6 | 510 |
| Gelatin | | |
| Dessert flavored Jell O | 330 | 210 |
| Plain | 36 | 22 |
| Gin | 0.7 | 0.3 |
| Ginger | 29 | 1100 |
| Ginger ale | 8 | 0.6 |
| Gizzard turkey | 58 | 170 |
| Gluten flour | 2 | 24 |
| Goose raw | | |
| Breast meat | 76 | 420 |
| Leg meat | 96 | 420 |
| Gooseberry | | |
| Frozen | 2 | 150 |
| Raw | 0.7 | 87 |
| Grapes | | |
| Concord less seeds and skin | 3 | 81 |

Table 140 (Continued)

| Food | Sodium (mg / 100 gm) | Potassium (mg / 100 gm) |
|---|---|---|
| Emperor, less seeds with skin | 4 | 180 |
| Jam | 7 | 78 |
| Juice Concord sweetened bottled | 1 | 120 |
| Thompson Seedless with skin | 4 | 180 |
| Tokay less seeds with skin | 0.7 | 160 |
| Grapefruit | | |
| Fresh | 0.5 | 200 |
| Juice sweetened canned | 0.4 | 150 |
| Sections sweetened frozen | 5 | 60 |
| Grape Nuts cereal | 660 | 230 |
| Gravy flavoring Kitchen Bouquet | 86 | 280 |
| Gum chewing spearmint | 22 | 27 |
| Halibut | | |
| Raw | 56 | 540 |
| Steak frozen | 460 | 500 |
| Ham raw | 1100 | 340 |
| Hash corned beef canned | 540 | 200 |
| Hazelnuts—See filberts | | |
| Heart | | |
| Beef | 90 | 160 |
| Turkey | 69 | 240 |
| Hominy canned | 250 | 22 |
| Honey | 7 | 10 |
| Horse radish prepared | 96 | 290 |
| Ice cream | 100 | 90 |
| Jam grape | 7 | 78 |
| Kale leaves and midribs | 110 | 410 |
| Kidney beef | 210 | 310 |
| Kumquat pulp and rind less seeds | 7 | 230 |
| Lactalbumin | 47 | 69 |
| Lactose U S P | 2 | 0 |
| Lamb | | |
| Chop lean raw | 98 | 340 |
| Leg lean raw | 78 | 380 |
| Lard | 0.3 | 0.[illegible] |
| Lemon lime soda | 7 | 33 |
| Lemons | | |
| Peel | | |
| Candied | 50 | 12 |
| Fresh | 9 | 360 |
| Pulp and juice | 0.7 | 130 |
| Lentils dry | 3 | 1200 |
| Lettuce | | |
| Head | 12 | 140 |
| Leaf | 7 | 230 |
| Lime pulp and juice | 1 | 100 |
| Litchi dried | 3 | 1100 |
| Liver raw | | |
| Calf | 110 | 380 |
| Goose | 140 | 230 |
| Pig | 77 | 350 |
| Turkey | 51 | 160 |
| Lobster boiled in tap water | 210 | 180 |
| Lonalac dry | 13 | 1300 |
| Macaroni plain dry | 1 | 160 |
| Mace | 45 | 180 |
| Maize—See corn | | |
| Maltex cereal dry | 4 | 250 |
| Maple sirup | 14 | 130 |
| Marmalade orange | 13 | 19 |
| Matzoth | | |
| American style (salted) | 470 | 120 |
| Egg | 16 | 160 |
| Farfel (dough balls) | 28 | 130 |
| Meal | 4 | 130 |
| Passover (Passover bread) | 1 | 140 |
| Plain | 1 | 160 |
| Poppy seed | 850 | 110 |
| Thin tea | 2 | 130 |
| Whole wheat | 280 | 420 |
| Mayonnaise | 590 | 25 |
| Meat extract flavored | 11 000 | 6000 |
| Milk | | |
| *Cow's* | | |
| Buttermilk cultured | 130 | 140 |
| Condensed sweetened | 140 | 340 |
| Evaporated | 100 | 270 |
| Fat | 0.4 | 0.3 |
| Skim | 52 | 150 |
| Whole | | |
| Dry | 410 | 1100 |
| Liquid | 50 | 140 |
| Goat's | 34 | 180 |
| Human | | |
| From 10 mothers 3 to 10 days post partum | 37 | 68 |
| From 4 mothers 49 to 77 days post partum | 11 | 51 |
| Low sodium—See Lonalac | | |
| Malted dry | 440 | 720 |
| Molasses cane | 80 | 1500 |
| Muffets cereal | 4 | 300 |
| Mulberry | 0.7 | 200 |

Table 140 (Continued)

| Food | Sodium (mg / 100 gm) | Potassium (mg / 100 gm) |
|---|---|---|
| Mushrooms | | |
| Canned | 400 | 150 |
| Raw | 5 | 520 |
| Mustard | | |
| Greens | 48 | 450 |
| Powder | 3 | 840 |
| Prepared paste | 1300 | 130 |
| Nectarine less skin | 2 | 320 |
| Nutmeg | 14 | 160 |
| Oats rolled (oatmeal) dry | 2 | 340 |
| Okra fresh | 1 | 220 |
| Oleomargarine | 1100 | 58 |
| Olives | | |
| Green pickled | 2400 | 55 |
| Oil | 0.2 | 0.2 |
| Ripe pickled | 980 | 23 |
| Stuffed pickled | 2800 | 55 |
| Onion less tops and dry skins | 1 | 130 |
| Orange Crush | 2 | 100 |
| Oranges | | |
| Juice unsweetened canned | 0.5 | 190 |
| Pulp and juice | 0.3 | 170 |
| Temple pulp and juice | 3 | 220 |
| Oyster raw | 73 | 110 |
| Pabena cereal dry | 640 | 340 |
| Pablum cereal dry | 620 | 380 |
| Pancreas pig raw | 57 | 240 |
| Paprika | 82 | 2300 |
| Parsley fresh | 28 | 880 |
| Parsnip scraped and trimmed fresh | 7 | 740 |
| Peaches | | |
| Canned in sirup | 5 | 31 |
| Dried | 12 | 1100 |
| Frozen in sirup | 3 | 120 |
| Raw less skin | 0.5 | 160 |
| Peanuts | | |
| Butter | 120 | 820 |
| Oil | 0.2 | 0.1 |
| Raw with skin | 2 | 720 |
| Roasted | | |
| Dry with skin | 2 | 740 |
| In oil and salted with skin | 460 | 700 |
| Pears | | |
| Bartlett | | |
| Canned in sirup | 8 | 52 |
| Raw less skin and core | 2 | 100 |
| Peas | | |
| Canned less liquor | 270 | 96 |
| Dry split | 42 | 880 |
| Fresh | 1 | 370 |
| Frozen | 100 | 160 |
| Pecan raw | 0.3 | 420 |
| Pectin solution Certo | 15 | 110 |
| Pepper (spice) | | |
| Black | 16 | 880 |
| Red | 46 | 2400 |
| White | 5 | 48 |
| Peppermint extract | 0.3 | 5 |
| Peppers green empty pods | 0.6 | 170 |
| Pepsi Cola | 15 | 3 |
| Persimmon wild | 0.6 | 310 |
| Pettijohn's cereal dry | 2 | 380 |
| Pickle dill | 1400 | 200 |
| Pilchard—See sardine | | |
| Pineapple | | |
| Canned in sirup | 1 | 120 |
| Frozen in sirup | 1 | 38 |
| Juice unsweetened canned | 0.5 | 140 |
| Raw | 0.3 | 210 |
| Plums | | |
| Canned in sirup | 18 | 110 |
| Raw | 0.6 | 170 |
| Polyvitamin dispersion Mead's dry | 6 | 10 |
| Pomegranate pulp and juice | 0.3 | 200 |
| Popcorn | | |
| Popped | | |
| Oiled | 3 | 240 |
| Oiled and salted | 2000 | 210 |
| Pork | | |
| Lean raw | 58 | 260 |
| Salt | 1800 | 27 |
| Postum | | |
| Cereal beverage dry | 36 | 1300 |
| Instant dry | 71 | 2200 |
| Potatoes | | |
| Chips | 340 | 880 |
| Sweet | | |
| Canned | 48 | 200 |
| Raw less skin | 4 | 530 |
| White | | |
| Canned | 350 | 240 |
| Raw less skin | 0.8 | 410 |
| Poultry seasoning | 26 | 840 |
| Pretzel | 1700 | 130 |
| Protenum dry | 360 | 1100 |
| Prunes | | |
| Canned in sirup | 3 | 220 |
| Dried | 6 | 600 |
| Juice unsweetened bottled | 2 | 260 |
| Raw with skin | 0.7 | 210 |

**Table 140 (Continued)**

| Food | Sodium (mg / 100 gm ) | Potassium (mg / 100 gm ) |
|---|---|---|
| Pumpkin | | |
| Canned | 2 | 240 |
| Raw less rind and seeds | 0 6 | 480 |
| Quail raw | | |
| Breast meat | 35 | 160 |
| Leg meat | 44 | 190 |
| Quince less skin and core raw | 0 7 | 290 |
| Rabbit domesticated raw | | |
| Foreleg | 47 | 370 |
| Loin | 34 | 400 |
| Radish with skin | 9 | 260 |
| Raisin | | |
| Seedless | 21 | 720 |
| Zante | 22 | 730 |
| Ralston cereal Instant dry | 1 | 360 |
| Raspberries | | |
| Black | 0 3 | 190 |
| Oriental (wineberry) | 0 9 | 170 |
| Red | 0.5 | 130 |
| Rennet tablets Junket | 38 000 | 36 |
| Rhubarb | | |
| Frozen in sirup | 2 | 160 |
| Raw | 1 | 70 |
| Rice dry | | |
| Brown | 9 | 150 |
| Flakes | 720 | 180 |
| Polished and coated | 2 | 130 |
| Puffed | 0 9 | 100 |
| Vitaminized | 4 | 170 |
| Wild (*Zizania*) | 7 | 220 |
| Root beer | 8 | 0 5 |
| Royal Crown Cola | 5 | 2 |
| Rum | 2 | 3 |
| Rutabaga (yellow turnip) less skin and tops raw | 5 | 260 |
| Ry Krisp | 1500 | 600 |
| Sage | 20 | 670 |
| Salmon | | |
| Canned | 540 | 300 |
| Raw | 48 | 410 |
| Salt—theoretical value for pure NaCl | 39 342 | 0 |
| Sardines | | |
| Herring canned in oil | 510 | 560 |
| Pilchard | | |
| Canned in natural sauce | 760 | 260 |
| Canned in tomato sauce | 400 | 320 |
| Sauerkraut canned | 630 | 140 |
| Sausage | | |
| Bologna | 1300 | 230 |
| Frankfurt | 1100 | 220 |
| Pork | 740 | 140 |
| Scallop frozen | 150 | 420 |
| Shortening vegetable | | |
| Crisco | 4 | 0 |
| Spry | 0 4 | 0 2 |
| Shrimp raw | 140 | 220 |
| Sirup | | |
| *Chocolate Hershey* | *60* | *130* |
| Maple | 14 | 130 |
| Sorghum | 21 | 600 |
| Table corn and cane | | |
| Karo Crystal White | 68 | 4 |
| Soda baking—*theoretical value for* pure $NaHCO_3$ | 27 373 | 0 |
| Soft drinks | | |
| Carbonated water | | |
| Canada Dry | 18 | 0 6 |
| Made with Sparklet carbon dioxide capsule and distilled water | 0 | 0 |
| White Rock | 1 | 0 6 |
| *Coca Cola* | *1* | *52* |
| Ginger ale | 8 | 0 6 |
| Lemon lime soda | 7 | 33 |
| Orange crush | 2 | 100 |
| Pepsi Cola | 15 | 3 |
| Royal Crown Cola | 5 | 2 |
| Root beer | 8 | 0 5 |
| Sorghum sirup | 21 | 600 |
| Soup | | |
| Beef canned diluted as served | *110* | *100* |
| Tomato canned diluted as served | 380 | 110 |
| Vegetable canned diluted as served | 380 | 120 |
| Soybeans | | |
| Dry | 4 | 1900 |
| Flour solvent extracted | 1 | 1700 |
| Spaghetti—See macaroni | | |
| Spinach | | |
| Canned | 320 | 260 |
| Frozen | 60 | 380 |
| Raw | 82 | 780 |
| Spry (vegetable shortening) | 0 4 | 0 2 |
| Squash raw | | |
| Acorn less rind and seeds | 0 4 | 260 |

Table 140 (Continued)

| Food | Sodium (mg / 100 gm) | Potassium (mg / 100 gm) |
|---|---|---|
| Hubbard less rind and seeds | 0.3 | *210* |
| White summer less rind with seeds | 0.2 | 150 |
| Yellow summer less rind with seeds | 0.6 | 200 |
| Squash cooked frozen | 6 | 120 |
| Starch corn | 4 | 4 |
| Strawberries | | |
| Frozen sweetened | 2 | 180 |
| Raw | 0.8 | 180 |
| Sugar | | |
| Light brown | 24 | 230 |
| White | 0.3 | 0.5 |
| Sweetbreads—See pancreas and thymus | | |
| Tangerines | | |
| Juice sweetened canned | 0.6 | 170 |
| Pulp and juice | 2 | 110 |
| Tapioca dry | 5 | 19 |
| Tea India Ceylon Java *blend dry* | *4* | *1800* |
| Thyme | 38 | 500 |
| Thymus beef raw | 96 | 360 |
| Tobacco chewing *Spark Plug* | *1600* | *1800* |
| Tomatoes | | |
| Canned | 18 | 130 |
| Catchup | 1300 | 800 |
| Juice canned | 230 | 230 |
| Raw with skin | 3 | 230 |
| Tongue beef raw | 100 | 260 |
| Tripe pickled | 46 | 19 |
| Tuna canned | 800 | 210 |
| Turkey raw | | |
| Breast meat | 40 | 320 |
| Leg meat | 92 | 310 |
| Turmeric | 22 | 2700 |
| Turnips raw | | |
| Leaves | 10 | 110 |
| White less skin and tops | 37 | 230 |
| Yellow (rutabaga) less skin and tops | 5 | 260 |
| Vanilla extract | 1 | 74 |
| Veal lean raw | 48 | 330 |
| Vinegar | | |
| Cider | 1 | 100 |
| Distilled | 0.6 | 15 |
| Walnuts raw | | |
| Black | 3 | *460* |
| English | 2 | 450 |
| Water—carbonated—See soft drinks | | |
| Watermelon pink part *of fruit* | *0.3* | *110* |
| Wheat | | |
| Beeswing (outermost coats) | 4 | 360 |
| Bran crude | 15 | 980 |
| Flakes cereal | 1300 | 320 |
| Germ | | |
| Crude | 2 | *780* |
| Malt flavored Zing | 9 | 780 |
| Gluten | 2 | 21 |
| Puffed | 4 | 340 |
| Scourings (dirt and fragments) | 8 | 470 |
| Shredded | 2 | 330 |
| Winter scoured—4 *samples* | *2* | *370* |
| Wheatena cereal dry | 2 | 380 |
| Whiskey | | |
| Blended | 0.3 | 1 |
| Bonded | 0.1 | 0.6 |
| Wild rice (*Zizania*) dry | 7 | 220 |
| Wine | | |
| Port | 4 | 75 |
| Sauterne | 10 | 87 |
| Wineberry (oriental raspberry) | 0.9 | 170 |
| Worcestershire sauce | 2100 | 480 |
| Yeast | | |
| Compressed | 4 | 360 |
| Debittered brewers dry | 150 | 1700 |
| Primary cultured dry 19 samples | | |
| Maximum | 320 | 2200 |
| Minimum | *9* | *1700* |
| Average | 115 | 1860 |
| Zwieback | 250 | 150 |

Table 141 Sodium and Potassium Content of Public Water Supplies*

| Place | Sodium mg / 100 cc | Potassium mg / 100 cc |
|---|---|---|
| Aberdeen S D | 20 | 2 |
| Albany N Y | 0.2 | 0.2 |
| Albuquerque N M | 5 | 0.7 |
| Allentown Pa | 0.4 | 0.3 |
| Annapolis Md | 0.2 | 0.2 |
| Ann Arbor Mich | 2 | 0.5 |
| Atlanta Ga | 0.2 | 0.2 |
| Augusta Me | 0.2 | 0.2 |
| Austin Texas | 3 | 0.5 |
| Baltimore Md | 0.3 | 0.2 |
| Bangor Me | 0.2 | 0.1 |
| Baton Rouge La | 9 | 0.2 |
| Beloit Wis | 0.5 | 0.2 |
| Billings Mont | 1 | 0.2 |
| Biloxi Miss | 23 | 0.6 |
| Birmingham Ala | 2 | 0.3 |
| Bismarck N D | 6 | 0.6 |
| Boise Idaho | 2 | 0.3 |
| Boston Mass | 0.3 | 0.2 |
| Brownsville Texas | 6 | 0.3 |
| Brownwood Texas | 2 | 0.4 |
| Buffalo N Y | 0.7 | 0.3 |
| Burlington Vt | 0.2 | 0.1 |
| Butte Mont | 0.6 | 0.4 |
| Camden N J | 0.9 | 0.3 |
| Carson City Nev | 0.4 | 0.3 |
| Charleston S C | 1 | 0.3 |
| Charleston W Va | 0.3 | 0.2 |
| Charlotte N C | 0.3 | 0.1 |
| Charlottesville Va | 0.2 | 0.1 |
| Cheyenne Wyo | 0.3 | 0.2 |
| Chicago Ill | 0.3 | 0.1 |
| Cincinnati Ohio | 0.7 | 0.3 |
| Cleveland Ohio | 1 | 0.3 |
| Columbia S C | 0.4 | 0.2 |
| Columbus Ohio | 5 | 0.6 |
| Concord N H | 0.2 | 0.1 |
| Corpus Christi Texas | 15 | 0.6 |
| Crandall Texas | 170† | 0.5 |
| Dallas Texas | 3 | 0.5 |
| Dayton Ohio | 0.7 | 0.2 |
| Denver Colo | 3 | 0.2 |
| Des Moines Iowa | 1 | 0.4 |
| Detroit Mich | 0.3 | 0.1 |
| Dover Del | 2 | 0.5 |
| Durham N C | 0.4 | 0.2 |
| El Paso Texas | 7 | 0.6 |
| Emporia Kans | 1 | 0.3 |
| Eureka Calif | 0.7 | 0.6 |
| Evansville Ind | 2 | 0.5 |
| Fargo N D | 5 | 0.7 |
| Flint Mich | 2 | 0.2 |
| Frankfort Ky | 0.3 | 0.1 |
| Galesburg Ill | 30 | 2 |
| Galveston Texas | 34 | 0.7 |
| Grand Forks N D | 6 | 0.4 |
| Hamilton Ohio | 3 | 0.2 |
| Harrisburg Pa | 0.2 | 0.1 |
| Hartford Conn | 0.2 | 0.1 |
| Helena Mont | 0.3 | 0.2 |
| Houston Texas | 16 | 0.6 |
| Huntington W Va | 3 | 0.2 |
| Independence Mo | 9 | 0.5 |
| Indianapolis Ind | 1 | 0.3 |
| Iowa City Iowa | 0.5 | 0.3 |
| Jackson Mich | 5 | 0.3 |
| Jackson Miss | 0.4 | 0.2 |
| Jacksonville Fla | 1 | 0.2 |
| Jefferson City Mo | 3 | 0.4 |
| Jersey City N J | 0.3 | 0.2 |
| Joplin Mo | 0.5 | 0.1 |
| Kalamazoo Mich | 0.7 | 0.3 |
| Kansas City Kans | 4 | 0.4 |
| Kansas City Mo | 10 | 3 |
| Lancaster Pa | 0.4 | 0.1 |
| Lansing Mich | 1 | 0.5 |
| Lawrence Kans | 4 | 0.7 |
| Lincoln Neb | 3 | 0.7 |
| Little Rock Ark | 0.1 | 0.1 |
| Los Angeles Calif | | |
| Aqueduct source | 6 | 0.6 |
| Metropolitan source | 17 | 0.5 |
| River source | 5 | 0.5 |
| Louisville Ky | 2 | 0.3 |
| Madison Wis | 0.4 | 0.2 |
| Manchester N H | 0.2 | 0.1 |
| Marion Ohio | 17 | 0.7 |
| Memphis Tenn | 2 | 0.3 |
| Miami Fla | 2 | 0.3 |
| Middletown Ohio | 0.8 | 0.1 |
| Milwaukee Wis | 0.3 | 0.1 |
| Minneapolis Minn | 0.5 | 0.3 |
| Minot N D | 25 | 0.6 |
| Moberly Mo | 0.3 | 0.2 |
| Montgomery Ala | 0.8 | 0.1 |
| Montpelier Vt | 0.1 | 0.1 |
| Nashville Tenn | 0.3 | 0.2 |
| Newark N J | 0.2 | 0.1 |
| New Haven Conn | 0.3 | 0.1 |
| New Orleans La | 1 | 0.4 |
| New York N Y | 0.3 | 0.2 |
| Oakland Calif | 0.3 | 0.1 |
| Oklahoma City Okla | 10 | 0.8 |
| Olympia Wash | 0.5 | 0.3 |
| Omaha Neb | 8 | 1 |
| Philadelphia Pa | 2 | 0.4 |
| Phoenix Ariz | 11 | 0.7 |
| Pierre S D | 9 | 0.5 |
| Pittsburgh Pa | 6 | |

* Bills C E and others J Am Dietet A 25 304 1949

† An extreme example This water is rarely drunk but is used for

Table 141 (Continued)

| Place | Sodium mg / 100 cc | Potassium mg / 100 cc | Place | Sodium mg / 100 cc | Potassium mg / 100 cc |
|---|---|---|---|---|---|
| Portland Me | 0 2 | 0 1 | Seattle Wash | 0.2 | 0 1 |
| Portland Ore | 0 1 | 0 1 | Sedalia Mo | 0 3 | 0.2 |
| Providence R I | 0 2 | 0 1 | Shreveport La | 2 | 0 1 |
| Raleigh N C | 0 4 | 0 1 | Sioux Falls S D | 1 | 0 4 |
| Reno Nev | 0 5 | 0 1 | Springfield Ill | 0 8 | 0 3 |
| Richmond Va | 0 7 | 0 2 | Springfield Mo | 0 4 | 0 2 |
| Rochester, Minn | 0 7 | 0 2 | Syracuse N Y | 0 2 | 0 1 |
| Rochester N Y | 0 3 | 0 2 | Tallahassee Fla | 0 3 | 0 1 |
| Rockford Ill | 0 7 | 0 2 | Tampa Fla | 0.5 | 0 1 |
| Sacramento Calif | 0 3 | 0 2 | Texarkana Ark | 3 | 0 2 |
| *Santa Fe N M* | *0 4* | *0 1* | *Topeka Kans* | *1* | *0.5* |
| St Joseph Mo | 9 | 0 6 | Trenton N J | 0 1 | 0 1 |
| *St Louis Mo* | *5* | *0 5* | *Tucson Ariz* | *3* | *0.3* |
| St Paul Minn | 0.5 | 0 3 | Tulsa Okla | 0 3 | 0 4 |
| St Petersburg Fla | 0.5 | 0 1 | Uniontown Pa | 0 2 | 0 1 |
| Salem Ore | 0 2 | 0 1 | Upper Darby, Pa | 0 4 | 0 2 |
| Salt Lake City Utah | 0 8 | 0 2 | Washington D C | 0 3 | 0 3 |
| San Angelo Texas | 5 | 0 9 | Whittier, Calif | 1 | 0 2 |
| San Antonio Texas | 1 | 0 1 | Wichita Kans | 5 | 0 5 |
| San Diego Calif | 5 | 0 5 | Wilkes Barre Pa | 0 2 | 0 1 |
| San Francisco Calif | 1 | 0 3 | Wilmington Del | 0 8 | 0 1 |
| *Santa Barbara Calif* | *10* | *0 3* | *Winona Minn* | *5* | *0 4* |

Table 142 Foods Accepted* by the Council on Foods and Nutrition of the American Medical Association for Use in Low Sodium Diets

| | Sodium Content mg /100 gm |
|---|---|
| Allen Foods Inc St Louis Missouri | |
| Lasco Brand | |
| Dietetic Pack Tuna Fish | 40 |
| *Aslesen Company Minneapolis Minnesota* | |
| Banquet Table Brand | |
| Dietetic Pack All Green Asparagus | |
| Dietetic Pack Spinach | |
| Bercut Richards Packing Company Sacramento California | |
| Sacramento Brand | |
| Dietetic Pack Asparagus | 20 |
| Dietetic Pack Tomatoes | 20 |
| Dietetic Pack Tomato Juice | 20 |
| Chicago Dietetic Supply House Inc Chicago Illinois | |
| Cellu Brand | |
| Dietetic Pack Cut Spears of Green Asparagus | |
| Dietetic Pack Green Stringless Beans | |
| Dietetic Pack Green Lima Beans | |
| Dietetic Pack Whole Wax Beans | |
| *Dietetic Pack Tiny Beets* | |
| Dietetic Pack Carrots | |
| Dietetic Pack Cauliflower | |
| Dietetic Pack Whole Kernel Golden Corn | |
| Dietetic Pack Mushrooms | |
| Dietetic Pack Peas and Carrots | |
| Dietetic Pack Rhubarb | |
| Dietetic Pack Spinach | |
| Dietetic Pack Tomatoes | |
| Dietetic Pack Tomato Juice | |
| | 16 4 |
| 1 | 40 |
| | 4 |

Table 142 (Continued)

| [illegible] | | Sodium Content mg /100 gm |
|---|---|---|
| Low Sodium Wheat Bread | | 4 |
| Low Sodium Cake | | 10 |
| Empire Dehydrated Products Inc Brooklyn N Y | | |
| Low Sodium Soup Base Chicken Flavor | | |
| Luda Brand | | |
| (with monosodium glutamate) | Dehydrated Base | 207 |
| Low Sodium Soup Base Chicken Flavor (without monosodium glutamate) | Dehydrated Base | 84 |
| Haas Baruch and Company Los Angeles California | | |
| Iris Brand | | |
| Dietetic Pack Tuna Fish (Chunklets) | | 40 |
| Haxton Foods Inc Oakfield New York | | |
| Blue Boy Brand | | |
| Dietetic Pack Green Beans | | 1 0 |
| Dietetic Pack Lima Beans | | 10 3 |
| Dietetic Pack Wax Beans | | 0 8 |
| Dietetic Pack Diced Beets | | 19 4 |
| Dietetic Pack Sliced Beets | | 46.5 |
| Dietetic Pack Whole Beets | | 36 0 |
| Dietetic Pack Diced Carrots | | 50 1 |
| Dietetic Pack Corn on the Cob | | 0 9 |
| Dietetic Pack Cream Style Corn | | 3 2 |
| Dietetic Pack Whole Kernel Corn | | 1 2 |
| Dietetic Pack Peas | | 8 6 |
| Dietetic Pack Peas and Carrots | | 14 9 |
| Dietetic Pack Spinach | | 9 1 |
| Hilsom Corporation New York City | | |
| Hilsom Brand | | |
| Dietetic Pack Beef and Gravy | | 15 |
| Dietetic Pack Beef Hash | | 16 |
| Dietetic Pack Beef Stew | | 15 |
| Dietetic Pack Chili Con Carne (with Beans) | | 33 |
| Dietetic Pack Meat Sauce | | 5 |
| Kretschmer Corporation Carrollton Michigan | | |
| Kretschmer s Wheat Germ | | 3 8 |
| Mead Johnson and Company Evansville Indiana | | |
| Lonalac—Low Sodium Powdered Milk | | 20 |
| Louis Milani Foods Inc Los Angeles California | | |
| Diafood Brand | | |
| Low Sodium Beef Soup Base | Rehydrated food as served | 7 |
| Low Sodium Chicken Soup Base | Rehydrated food as served | 0 8 |
| Low Sodium Jellied Consomme (Powdered) | Rehydrated food as served | 0 3 |
| Low Sodium Powdered Consomme | Rehydrated food as served | 0 5 |
| B M Mishler Company Pasadena California | | |
| Bradford Brand | | |
| Dietetic Pack Tuna Fish | | 40 |
| Neuman Pastry Shops Chicago Illinois | | |
| Neuman s Brand | | |
| Low Sodium White Wheat Bread | | 4 |
| Low Sodium Cake | | 10 |
| S S Pierce Company Boston Massachusetts | | |
| Overland Brand | | |
| Dietetic Pack Green Beans | | 1 0 |
| Dietetic Pack Cut Wax Beans | | 0 8 |
| Dietetic Pack Beets | | 19 4 |
| D | | [illegible] |

| Table 142 (Continued) | Sodium Content mg/100 gm |
|---|---|
| Dietetic Pack Whole Kernel Corn | 1.2 |
| Dietetic Pack Sweet Peas | 8.6 |
| Dietetic Pack Spinach | 9.1 |
| Pratt Low Preserving Company Santa Clara California | |
| Pratt Low Brand—also Chimes Brand | |
| Dietetic Pack All Green Asparagus | |
| Dietetic Pack Green Tipped and White Asparagus | |
| Dietetic Pack Cut Blue Lake Beans | |
| Dietetic Pack Spinach | |
| Reid Murdoch and Company Chicago Illinois | |
| Monarch Brand | |
| Dietetic Pack Asparagus (Cut Spears) | 1.0 |
| Dietetic Pack Asparagus (Whole Spears) | 1.0 |
| Dietetic Pack Cut Green Beans | 2.9 |
| Dietetic Pack Cut Wax Beans | 3.4 |
| Dietetic Pack Sliced Beets | 18.4 |
| Dietetic Pack Sliced Carrots | 53 |
| Dietetic Pack Peas | 3.0 |
| Dietetic Pack Spinach | 56.0 |
| Dietetic Pack Strained Green Beans | 1.6 |
| Dietetic Pack Strained Beets | 23 |
| Dietetic Pack Strained Carrots | 33 |
| Dietetic Pack Strained Peas | 21.0 |
| Dietetic Pack Strained Spinach | 2.0 |
| Richmond Chase Company San Jose California | |
| Diet Delight Brand | |
| Dietetic Pack Asparagus | 4 |
| Dietetic Pack Spinach | 49 |
| Dietetic Pack Tomatoes | |
| Van Camp Laboratories, Division of Van Camp Sea Food Company Inc Terminal Island California | |
| Chicken of the Sea Brand—also White Star Brand | |
| Dietetic Pack Tuna Fish | 40 |

* As of March 17 1952 The canned fruits and vegetables in this list are prepared without the addition of sugar and may therefore be recommended for use in low *Calorie diets*

## COMPOSITION OF FOODS—RAW, PROCESSED, PREPARED*

### Explanation* of Table 144

Table 144 provides information required when the percentage composition of the edible portion of foods is needed It contains information in the form wanted to calculate the nutrients in studies in which the food as eaten is weighed The foods are arranged alphabetically

Water, ash and fiber have been included, since probably this table will be used for most purposes requiring the more detailed information Reference to water content frequently is essential for the interpretation of data and for the correct application of figures For example differences shown in the energy value and protein or other nutrients in samples of wheat may be in part a matter of different moisture bases

* From Watt Bernice K and Merrill Annabel L with the assistance of Orr Martha Louise Wu Woot Tsuen and Pecot Rebecca Koonce United States Department of Agriculture Agriculture Handbook No 8 Washington D C Bureau of Human Nutrition and Home Economics Agricultural Research Administration 1950

used in reporting the data Ash as well as water content is useful in helping to define the product particularly when the information afforded can be used to indicate the extent of some form of processing such as drying or milling Fiber has been included because its content in the edible portion of foods is often requested

Table 144 is useful in estimating nutrient values of unweighed portions of foods as served and in rating individual diets in certain types of dietary surveys For many foods the unit shown is 1 cupful because this quantity can be adjusted readily to servings of various sizes For some foods the unit shown is a given number of ounces if that approaches a reasonable portion or serving and information is lacking for computing other units

The weights of common household units of food and their approximate measures shown in the table were taken from several sources published and unpublished or were calculated from the density of the food The weights thus obtained in many instances do not represent a high degree of accuracy for the volume or measure but the nutrient values are for the weight specified Weights per volume or count reported by different laboratories or individuals varied widely in many cases and the approximate measure and the food itself were not always adequately described in the report To minimize the errors in interpreting the units of measure and weight in the table descriptions have been made as specific and adequate as possible

## Sources of Data

The data in these Tables have been compiled over a period of years from published and unpublished literature and except in a few cases are averages of original analytical data It is not practicable to list the numerous sources in detail

Research at colleges universities and Agricultural Experiment Stations as well as research by scientific organizations and by industry have contributed the major portion of the data used for deriving the averages As new data on any food item became available in the literature or from unpublished sources they were added to the array on file if suitable and a new average derived For some foods chiefly in the case of the mineral content data were taken from other compilations especially published summaries of Henry C Sherman In other instances data are the result of investiga proxi mate compc Bureau of Fisheries ork in their laboratories

## Notes About Food Items

In preparing these Tables an effort has been made to derive values typical of the product available the year around throughout the country At present however it is impossible to prepare average composition

values that are uniformly representative for all foods or even for all constituents of any one food Some foods have been analyzed repeatedly for their content of a few nutrients and scarcely at all for other nutrients

*Cooked foods, a few prepared dishes, and frozen foods* have been included for the first time Figures for these items are preliminary in many cases based on very little experimental work However even in tentative form they more closely approximate the nutrient content of food as eaten than do data on uncooked foods As far as possible the data presented were based on summaries of reported analyses, where necessary however, values were imputed either from another form of the same food or from a similar food For example, in only a few cases were suitable analyses available on which to base figures for either the proximate or mineral composition of frozen foods or cooked vegetables Where actual data were lacking or appeared to be inconsistent the composition of the drained portion of the canned food or of the raw product was used

For cooked vegetables vitamin values are based on studies in which fair to good cooking procedures were followed Unless otherwise indicated, the values shown may be applied to vegetables cooked not too long in a moderate amount of water Amount of water and length of time required to bring water back to boiling are two of the more important factors in vitamin retention Small amounts of water and short heat up periods would result in higher vitamin content than shown in these tables Conversely, if the vegetable was started in a large amount of cold water, the values would be lower because of increased solution and destruction Reheated left over vegetables would have much less thiamine and ascorbic acid than shown by the figures in the tables

**Enriched Flour** The minimum levels for the required nutrients covered by the Federal enrichment legislation for flour have been entered in these tables These minimum levels are thiamine 2 0 mg riboflavin 1 2 mg niacin 16 mg and iron 13 mg per pound In addition to the amounts of iron and the three vitamins specified certain levels of vitamin D and calcium were permitted as optional ingredients Vitamin D is not included in these tables and except for self rising flours it has been assumed that manufacturers ordinarily do not add calcium

*Self rising flour* as usually prepared contains dicalcium phosphate although sometimes a sodium salt is used Self rising flour containing the calcium salt is estimated to have approximately 1235 mg of calcium per pound and this figure appears in the tables The minimum amount required for enrichment is only 500 mg per pound, hence both the enriched and the unenriched self rising flours, as customarily prepared have more calcium than the minimum level

**Bread and Rolls** The nutritive values shown for breads and rolls are the result of calculations made from formulas considered typical of present day commercial baking practices Breads with 2 per cent increments of nonfat milk solids up to the 6 per cent level (flour basis that is 6 pounds of nonfat milk powder per 100 pounds of flour) have been entered because this range is believed to cover most of the white breads sold For calculating nutritive values of diets when the level of milk

solids in commercial bread is unknown, the bread having milk solids *at the 4 per cent level (flour basis) is suggested because present* information indicates that the average amount of milk used is between 3 and 4 per cent (flour basis) Bread made with 4 pounds of milk solids to 100 pounds of flour contains approximately 2 5 per cent of milk solids after baking There is wide variation in the amount of milk used in bread Instances are known in which bakers use as much as three and four times the average A significant portion of the calcium content of breads shown in these tables is from the mold inhibitor In calculating the values for commercial white bread, it was assumed that 0 2 pound of calcium propionate was used to 100 pounds of flour In the 4 per cent milk bread, the calcium propionate would account for about 110 mg of the calcium in a pound of bread

Enriched bread may be made either with enriched flour or with unenriched flour plus such other ingredients that 1 pound of the finished product will have not less than the minimum or more than the maximum levels of certain nutrients as specified in the proposed Federal standards The amounts of the nutrients specified appeared in the Federal Register for August 3 1943, as follows

| | Minimum (Mg /lb ) | Maximum (Mg /lb ) |
|---|---|---|
| Iron | 8 0 | 12 5 |
| Thiamine | 1 1 | 1 8 |
| Riboflavin | 0 7 | 1 6 |
| Niacin | 10 0 | 15 0 |

The minimum levels of iron, thiamine riboflavin and niacin in the proposed specifications for enriched bread have been entered in these tables In calculating the nutrients it has been assumed that the breads were made with unenriched flour and that the amounts of the nutrients needed to meet the minimum levels specified for enrichment, in addition to the amounts contributed by the ingredients of the formula, would be supplied by adjusted enrichment preparations However, if enriched flour was used along with significant quantities of nonfat solids the level of these nutrients, riboflavin especially, would be higher The effect of increasing milk solids by 2 per cent increments may be observed by comparing the nutrient content of the unenriched breads having nonfat milk solids at the different levels specified

*Breakfast food cereals* on the market tend more and more to have added nutrients Nutritive values approximating some of these products have been included in the tables The nutrients usually added to these breakfast foods include one or more of the following iron, thiamine, riboflavin, and niacin Except for enriched farina and enriched grits there are at present no Federal standards regarding the addition of nutrients, either as to the nutrient that may be added or its level in the finished product The values for the breakfast foods with added nutrients shown in these tables are averages of the composition data reported for commercial products that have the same generic classification and have approximately the same levels of added nutrients Before using these data in any particular calculation, as in dietary stud

ies, it would be well to check the data with the information given on the packages of several kinds in the current market to see whether values in these tables are applicable.

*Meat* of medium fatness for each kind of animal makes up the main portion of meat consumed in this country and was therefore used as the basis for most of the data entered in the present tables.

Composition data for meat of other degrees of fatness are entered for the carcass or side as a whole. In addition, under pork, the item "miscellaneous lean cuts" has been included for use when a figure is needed to represent the total of the so-called lean cuts of a medium fat carcass that go into ordinary retail channels. Excluded are the lard, bacon, salt side, and fat back.

Reliable average values on the proximate composition of wholesale cuts have been available for several years and have been used generally in dietary calculations for estimating the nutritive values of meat. When wholesale cuts of medium fatness are trimmed, fat along with some bone and a little lean is often removed. The extent of the trimming is highly variable, and the composition of trimmed cuts cannot be estimated as accurately as that of wholesale cuts. For evaluating diets, the use of composition data on wholesale cuts, particularly in the case of beef, introduces considerable overestimation of fat and calories and a small underestimation of protein. The data for some of the fresh beef cuts shown in Table 144 have been adjusted to allow for a moderate amount of trimming. Data for all other fresh meat cuts, including lamb, pork, and veal, are from wholesale cuts considered most suitable.

Data for cooked meats were estimated from studies relating to changes in the composition of meat during cooking. Among the most important factors influencing these changes are temperature of cooking and degree of doneness. As far as possible, data used to derive values for cooked meat in these tables were from experiments in which the meat had been cooked to medium doneness at moderate temperatures by common methods suitable for the particular cut. Meat shrinks when cooked, losing water, fat, some mineral matter, and a little protein. The total loss in weight appears to be around 20 to 30 per cent for meat with bone and about 30 to 40 per cent for meat without bone. Meat roasted at a low temperature would be expected to shrink less than at higher temperatures. Reheating of left-over meat would reduce considerably the thiamine values shown in these tables.

### Notes on Nutrients and Other Components

*Refuse* figures in Tables 144 and 145 refer to the percentage of the total purchased weight that the homemaker usually discards in preparing food for the family table. Refuse includes bones, pits, shells, and other inedible material. For some foods it includes portions that could be eaten, but as a rule are discarded; for example, potato parings and tough outer leaves of vegetables. In general, data on refuse have been based on products in good condition and would not apply to produce with excessive bruising, insect infestation, or rot, nor would they apply

if peeling and trimming are done extravagantly In other words data shown here for refuse do not include *waste* The figures are considered suitable for use with food supplies purchased at retail, but generally are not satisfactory for use with fresh produce bought at wholesale

*Proximate composition* of food is the term which has come to be applied to the proportion of water, fat, carbohydrate, protein, and ash present in the food Each component is made up of substances having some properties in common, but may include smaller amounts of substances that are unrelated chemically This proximate grouping of long standing is convenient and is useful for many calculations

*Water* content includes volatile substances in addition to free water Most of the figures for moisture have been based on change in weight of a sample before and after heating to constant weight, in some cases in a vacuum oven, in others by air drying In recent years other methods of drying have been introduced, but frequently the method used for obtaining either moisture or total solids has not been stated in the reports All too often, especially in studies of the vitamin content of foods analyses for moisture or solids have not been reported at all

*Protein* values have been calculated from nitrogen content, nearly always total nitrogen, by applying suitable conversion factors such as those published by Jones * Counted with the true protein are other nitrogenous compounds such as amino acids and the purine bases In cases where the nonprotein nitrogen exclusive of amino acid nitrogen is fairly large, the figures for the protein content of the food have been adjusted to more nearly represent the sum of the true protein and amino acids present

*Fat* refers in the main to ether extractable materials, including in addition to the glyceryl esters of fatty acids or true fats various fatty acids sterols, chlorophyll, and other pigments or substances of similar solubility

*Carbohydrate,* frequently referred to as total carbohydrate by difference' is the term that has come to be used in this country to apply to the balance of the food components and is the difference between 100 per cent and the sum of the percentages of protein, fat, ash, and water In addition to the sugars and starches which the body uses almost completely, it includes other forms of carbohydrate which the body utilizes to a lesser degree if at all, such as fiber and pentosans Included also are other substances that are not carbohydrate such as organic acids

*Fiber* as it has usually been determined is that portion of the sample which resists solution when boiled in dilute acid and dilute alkali It is made up largely of celluloses, hemicellulose, and lignin

**Food Energy.** Calories are the units used for expressing food energy In these tables calories have been calculated by a modification of the procedure that has been in use in this country for fifty years Instead of applying the general calorie factors 4 9, 4 to the percentage composition of protein fat, and carbohydrate, respectively, as has usually been done heretofore, more specific factors have been developed for individual

* Jones D B Factors for Converting Percentages of Nitrogen in Foods and Feeds into Percentages of Protein U S Dept Agr Cir 183 1941

Table 143 Specific Physiological Energy Factors for Calculating the Calorie Values of Foods*

| Food or Food Group | Physiological Energy Factors to Be Applied to the Nutrients in Foods | | |
|---|---|---|---|
| | Protein | Fat | Carbohydrates (by Difference) |
| | Cal /gm | Cal /gm | Cal /gm |
| Meat, poultry, fish | 4 27 | 9 02 | † |
| Eggs | 4 36 | 9 02 | 3 68 |
| Milk, milk products | 4 27 | 8 79 | 3 87 |
| Fats, animal | | | |
| Butter | 4 27 | 8 79 | 3 87 |
| Other animal fats | | 9 02 | |
| Fats, vegetable | | | |
| Margarine | 4 27 | 8 84 | 3 87 |
| Other vegetable fats and oils, hydrogenated fats | | 8 84 | |
| Sugars, sirups, and other sweets | | | |
| Cane or beet sugar | | | 3 87 |
| Glucose, other monosaccharides | | | 3 68 |
| Honey | 3 36 | | 3 68 |
| Jams, jellies, marmalades preserves | 3 36 | 8 37 | 3 87 |
| Molasses, other table sirups | | | 3 87 |
| Cereals and other grain products | | | |
| Barley, light | 3 55 | 8 37 | 3 95 |
| Bran (almost wholly bran) | 1 82 | 8 37 | 2 58 |
| Bran (40 per cent) flakes | 1 82 | 8 37 | 3 26 |
| Bran, raisin | 2 20 | 8 37 | 3 34 |
| Buckwheat flour, dark | 3 37 | 8 37 | 3 78 |
| Buckwheat flour, light | 3 55 | 8 37 | 3 95 |
| Corn flour | 3 46 | 8 37 | 4 16 |
| Corn flakes | 3 46 | 8 37 | 4 16 |
| Corn grits, degermed | 3 46 | 8 37 | 4 16 |
| Corn meal, whole ground, unbolted | 2 73 | 8 37 | 4 03 |
| Corn meal, whole ground, bolted | 3 10 | 8 37 | 4 10 |
| Corn meal, degermed | 3 46 | 8 37 | 4 16 |
| Crackers, graham | 3 59 | 8 37 | 3 78 |
| Crackers, soda, plain | 4 23 | 8 37 | 4 12 |
| Farina | 4 05 | 8 37 | 4 12 |
| Macaroni, spaghetti | 3 91 | 8 37 | 4 12 |
| Noodles, egg | 3 91 | 8 80 | 4 12 |
| Oatmeal, rolled oats | 3 55 | 8 37 | 4 07 |
| Popcorn | 2 73 | 8 37 | 4 03 |
| Pretzels | 4 00 | 8 37 | 4 12 |
| Rice, brown | 3 41 | 8 37 | 4 12 |
| Rice, white or polished | 3 82 | 8 37 | 4 16 |
| Rice, flakes, puffed | 3 82 | 8 37 | 4 16 |
| Rye meal or whole grain | 3 05 | 8 37 | 3 86 |
| Rye flour, dark | 2 96 | 8 37 | 3 82 |
| Rye flour, medium | 3 23 | 8 37 | 3 99 |
| Rye flour, light | 3 46 | 8 37 | 4 07 |
| Rye wafers | 3 05 | 8 37 | 3 86 |
| Starch | 3 87 | 8 37 | 4 12 |

Table 143 Specific Physiological Energy Factors for Calculating the Caloric Values of Foods*—(Continued)

| Food or Food Group | Physiological Energy Factors to Be Applied to the Nutrients in Foods | | |
|---|---|---|---|
| | Protein | Fat | Carbohydrates (by Difference) |
| | Cal /gm | Cal /gm | Cal /gm |
| Tapioca | 3 87 | 8 37 | 4 12 |
| Wheat, 97–100 per cent extraction | 3 59 | 8 37 | 3 78 |
| Wheat, 85–93 per cent extraction | 3 78 | 8 37 | 3 95 |
| Wheat, 70–74 per cent extraction | 4 05 | 8 37 | 4 12 |
| Wheat and malted barley cereal | 3 32 | 8 37 | 3 86 |
| Wheat germ | 3 59 | 8 37 | 3 78 |
| Wheat—flaked, puffed, rolled shredded whole meal | 3 59 | 8 37 | 3 78 |
| Other refined cereals | 3 87 | 8 37 | 4 12 |
| Wild rice | 3 55 | 8 37 | 3 95 |
| Beans other legumes (pulses) nuts | | | |
| Soybeans—flakes, flour, grits | 3 47 | 8 37 | 1 68 |
| Other legumes, nuts | 3 47 | 8 37 | 4 07 |
| Vegetables | | | |
| Beans and peas, immature, shelled | 3 47 | 8 37 | 4 07 |
| Mushrooms | 2 43 | 8 37 | 1 24 |
| Potatoes sweetpotatoes starchy roots | 2 74 | 8 37 | 4 03 |
| Other underground crops‡ | 2 74 | 8 37 | 3 84 |
| Other vegetables | 2 44 | 8 37 | 3 57 |
| Tomatoes, tomato products | 3 36 | 8 37 | 3 60 |
| Fruits | | | |
| Lemons, limes | 3 36 | 8 37 | 2 70 |
| Other | 3 36 | 8 37 | 3 60 |
| Beverages | | | |
| Beer | 3 55 | | 3 98 |
| Carbonated beverages | | | 3 87 |
| Coffee soluble product | | | 3 68 |
| Tea, soluble product | | | 3 68 |
| Miscellaneous | | | |
| Alcohol§ | | | |
| Cocoa chocolate | 1 83 | 8 37 | 1 33 |
| Gelatin | 3 90 | 9 02 | |
| Glycogen | | | 4 11 |
| Vinegar | | | 2 45 |
| Yeast | 2 91 | 8 37 | 3 35 |

* Data from manuscript in preparation by Bureau of Human Nutrition and Home Economics as a U S Department of Agriculture publication

† Brain heart kidney liver 3 87 calories per gram tongue shellfish fish products, 4 11 calories per gram

‡ Vegetables such as beets carrots onions parsnips radishes.

§ 6.93 calories per gram may not be used by the body like other sources of energy

foods or food groups These more specific factors have been devel along the lines of Atwater s plan, but take into consideration the recent literature on digestibility and physiologic energy value of

*Ash* refers to the total mineral matter residue after ignition of the sample

*Calcium phosphorus and iron* data shown in these tables represent the total amounts of these elements present unless otherwise noted The question of how to treat the calcium content of foods containing relatively large amounts of oxalic acid remains debatable In these tables the total calcium content is given but attention is called in a footnote to the possibility that all of it may not be available because of the presence of the oxalic acid Likewise deductions were not made for phytin present in the food

*Vitamin values* in the literature for any one vitamin have been determined by a number of methods In some cases the early exploratory procedures have been replaced by methods now thought to be highly reliable but the more reliable methods have not yet been applied to all foods The application of better methods will call for a revision in some of the figures

*Vitamin A values* in these tables are expressed in International Units They have been based in part on biologic assay and in part on physical or chemical determinations of vitamin A itself or on one of its precursors The physiologic equivalence of vitamin A and of the carotenes having vitamin A activity has posed difficult questions Scientists around the globe are not entirely in agreement as to how much carotene is equivalent to an International Unit of vitamin A For these tables values expressed as micrograms of carotene were converted to International Units of vitamin A on the basis that 0 6 microgram of beta carotene and 1 2 micrograms of other carotenes having vitamin A activity were equivalent to 1 I U of vitamin A The problem of deriving suitable values for practical use in evaluating human diets is still further complicated by differences in availability of carotene from different sources Experimental work with laboratory animals and human subjects has shown that the carotene in some foods is nearly all available and in others only one third or less is available Future revisions of vitamin tables probably will require considerable change in vitamin A figures

Methods of extraction and assay for the three *B vitamins* (thiamine riboflavin niacin) included in these tables are still in the process of development Modifications of the preferred methods are resulting in greater sensitivity and precision and consequently in better agreement between methods Results of applying the improved procedures have not yet been reported for a great many foods consequently many of the values in these tables are based on older methods There is still considerable doubt concerning the adequacy of present methods for the release of the bound forms of riboflavin anomalous values are occasionally reported for the retention of this vitamin in foods that have been subjected to heat Niacin values in these tables were derived from data in the literature measuring nicotinic acid nicotinamide and related active compounds

*Ascorbic acid* values reported here have been based for the most part on determinations of reduced ascorbic acid because this was the form reported by most workers and is the form in which nearly all of this

vitamin occurs in fresh products Foods that have undergone storage or processing, however, have been found to contain significant quantities of the oxidized form (dehydroascorbic acid) Data on total ascorbic acid were used when authors reported data on both the reduced and the de hydro forms Since data for estimating total ascorbic acid were far less often reported there may be some underestimation of the vitamin C value of the foods On the other hand, recent developments in methods for measuring the vitamin C value of products show that some foods contain interfering substances which react chemically like the vitamin, but do not have the same physiologic activity These interfering sub stances are found especially in foods having a high carbohydrate content that have been subjected to heat or unfavorable storage conditions Con tinued research on methods and application of the improved procedures are needed to show to what extent present data need revision

## Signs and Symbols Used

An asterisk (*) in the table stub indicates an item for which the compo sition has been calculated from a recipe

Parentheses denote imputed values for which little or no experimental evidence was available, for which there was relatively little basis for imputing a value from another form of the food, or for which reported data were not considered suitable A zero in parenthesis is used where actual data were lacking and the amount of a constituent present was regarded as none or probably too little to measure

Dashes show that no basis could be found for imputing a value, al though there was some reason to believe that a measurable amount of the constituent might be present

The word "Trace" is used to indicate vitamin values that would round to zero with the number of decimal places carried in these tables For other components that would round to zero, a zero is used A zero followed by a decimal point indicates that there may be up to 0 5 of the unit present, but bases for showing the amount were inadequate Num bers with or without decimal points indicate that the average has been rounded to the nearest whole number or, for vitamin A, to the nearest multiple of ten

**Table 144 ** Composition of Foods, 100 Grams, Edible Portion**

| | Food and Description | Water (%) | Food Energy (Cal) | Protein (Gm) | Fat (Gm) | Carbohydrate (Gm) Total | Carbohydrate (Gm) Fiber | Ash (Gm) | Calcium (Mg) | Phosphorus (Mg) | Iron (Mg) | Vitamin A Value (IU) | Thiamine (Mg) | Riboflavin (Mg) | Niacin (Mg) | Ascorbic Acid (Mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Almonds dried unblanched | 4.7 | 597 | 18.6 | 54.1 | 19.6 | 2.7 | 3.0 | 254 | 475 | 4.4 | 0 | 0.25 | 0.67 | 4.6 | Trace |
| | Apples | | | | | | | | | | | | | | | |
| 2 | Raw | 84.1 | 58 | 0.3 | 0.4 | 14.9 | 1.0 | 0.3 | 6 | 10 | 0.3 | 90 | 0.04 | 0.03 | 0.2 | 5 |
| | Canned See *Applesauce* | | | | | | | | | | | | | | | |
| 3 | Dehydrated (small pieces) | 3.0 | 354 | 1.8 | 2.4 | 91.0 | 4.9 | 1.8 | 24 | 61 | 1.8 | (0) | 0.07 | 0.10 | 1.2 | 12 |
| | Dried | | | | | | | | | | | | | | | |
| 4 | Uncooked | 23.0 | 277 | 1.4 | 1.0 | 73.2 | 3.9 | 1.4 | 19 | 48 | 1.4 | (0) | 0.10 | 0.10 | 1.0 | 12 |
| | Cooked | | | | | | | | | | | | | | | |
| 5 | *Unsweetened | 78.1 | 79 | 0.4 | 0.3 | 20.8 | 1.1 | 0.4 | 5 | 14 | 0.4 | (0) | 0.02 | 0.03 | 0.3 | 2 |
| 6 | *Sweetened | 71.4 | 105 | 0.4 | 0.3 | 27.5 | 1.0 | 0.4 | 5 | 12 | 0.4 | (0) | 0.02 | 0.02 | 0.2 | 2 |
| 7 | Apples and apricots, canned, strained (infant food) | 82.3 | 63 | 0.4 | 0.3 | 16.5 | 0.5 | 0.5 | 11 | 16 | 1.0 | 1070 | 0.02 | 0.02 | 0.2 | 2 |
| 8 | *Apple betty | 64.2 | 150 | 1.7 | 2.9 | 30.6 | 0.8 | 0.6 | 15 | 25 | 0.1 | 160 | 0.06 | 0.04 | 0.5 | 1 |
| 9 | Apple butter | 53.1 | 184 | 0.4 | 0.8 | 45.4 | 1.1 | 0.3 | 14 | 21 | 0.6 | (0) | 0.01 | 0.02 | 0.2 | 2 |
| 10 | Apple juice, fresh or canned | 85.9 | 50 | 0.1 | (0) | 13.8 | | 0.3 | 6 | 10 | 0.5 | 40 | 0.02 | 0.03 | Trace | 1 |
| | Applesauce canned | | | | | | | | | | | | | | | |
| 11 | Unsweetened | 88.4 | 42 | 0.2 | 0.2 | 10.9 | 0.6 | 0.3 | 4 | 8 | 0.4 | 30 | 0.02 | 0.01 | Trace | 1 |
| 12 | Sweetened | 79.8 | 72 | 0.2 | 0.1 | 19.7 | 0.6 | 0.2 | 4 | 8 | 0.4 | 30 | 0.02 | 0.01 | Trace | 1 |
| 13 | Strained (infant food) | 83.1 | 61 | 0.5 | 0.2 | 16.0 | 0.6 | 0.2 | 5 | 7 | 0.4 | 80 | 0.01 | 0.02 | 0.2 | 2 |
| | Apricots | | | | | | | | | | | | | | | |
| 14 | Raw | 85.4 | 51 | 1.0 | 0.1 | 12.9 | 0.6 | 0.6 | 16 | 23 | 0.5 | 2790 | 0.03 | 0.05 | 0.8 | 7 |
| | Canned | | | | | | | | | | | | | | | |
| 15 | Water pack, solids and liquid | 90.9 | 32 | 0.5 | 0.1 | 8.1 | 0.3 | 0.4 | 10 | 15 | 0.3 | 1350 | 0.02 | 0.02 | 0.3 | 4 |
| 16 | Sirup pack, solids and liquid | 77.3 | 80 | 0.6 | 0.1 | 21.4 | 0.4 | 0.6 | 10 | 15 | 0.3 | 1350 | 0.02 | 0.02 | 0.3 | 4 |
| 17 | Strained (infant food) | 82.6 | 61 | 1.0 | 0.4 | 15.2 | 1.2 | 0.8 | 20 | 30 | (1.1) | (1700) | (0.02) | (0.02) | (0.2) | (3) |
| 18 | Dried, sulfured | 24.0 | 262 | 5.2 | 0.4 | 66.9 | 3.2 | 3.5 | 86 | 119 | 4.9 | 7430 | 0.01 | 0.16 | 3.3 | 12 |
| | Dried sulfured, cooked | | | | | | | | | | | | | | | |
| 19 | *Unsweetened, fruit and liquid | 75.3 | 85 | 1.7 | 0.1 | 21.8 | 1.0 | 1.1 | 28 | 39 | 1.6 | 2420 | Trace | 0.05 | 1,0 | 3 |
| 20 | *Sweetened, fruit and sirup | 65.8 | 123 | 1.5 | 0.1 | 31.6 | 0.9 | 1.0 | 24 | 34 | 1.4 | 2110 | Trace | 0.04 | 0.9 | 3 |
| 21 | Frozen | 77.8 | 82 | 0.7 | 0.1 | 21.0 | 0.4 | 0.4 | 11 | 16 | 0.4 | 1660 | 0.02 | 0.03 | 0.5 | 4 |
| | Asparagus | | | | | | | | | | | | | | | |
| 22 | Raw | 93.0 | 21 | 2.2 | 0.2 | 3.9 | 0.7 | 0.7 | 21 | 62 | 0.9 | 1000 | 0.16 | 0.19 | 1.4 | 33 |
| 23 | Cooked | 92.5 | 20 | 2.4 | 0.2 | 3.6 | 0.8 | 1.3 | 19 | 53 | 1.0 | 1040 | 0.13 | 0.17 | 1.2 | 23 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Canned, green* | | | | | | | | | | | | | | | |
| 24 | Solids and liquid | 93.6 | 18 | 1.9 | 0.3 | 2.9 | 0.5 | 1.3 | 18 | 43 | 1.7 | 600 | 0.07 | 0.10 | 0.9 | 15 |
| 25 | Drained solids | 92.5 | 21 | 2.4 | 0.4 | 3.4 | 0.8 | 1.3 | 19 | 53 | 1.9 | 800 | 0.06 | 0.08 | 1.0 | 18 |
| | Canned, bleached | | | | | | | | | | | | | | | |
| 26 | *Solids and liquid* | 93.3 | 18 | 1.6 | 0.3 | 3.3 | 0.5 | 1.5 | 15 | 33 | 0.9 | 50 | 0.05 | 0.07 | 0.8 | 15 |
| 27 | Drained solids | 92.3 | 22 | 2.1 | 0.5 | 3.6 | 0.8 | 1.5 | 16 | 41 | 1.0 | 80 | 0.05 | 0.08 | (0.9) | 18 |
| 28 | Frozen | 93.0 | 21 | 2.2 | 0.2 | 3.9 | 0.7 | 0.7 | 21 | 62 | 0.9 | 850 | 0.14 | 0.15 | 1.2 | 21 |
| | Asparagus beans See *Cowpeas* | | | | | | | | | | | | | | | |
| 29 | Avocados, raw† | 65.4 | 245 | 1.7 | 26.4 | 5.1 | 1.8 | 1.4 | 10 | 38 | 0.6 | 290 | 0.06 | 0.13 | 1.1 | 16 |
| | Bacon, medium fat | | | | | | | | | | | | | | | |
| 30 | Raw, slab or sliced | 20.0 | 630 | 9.1 | 65.0 | 1.1 | 0 | 4.3 | 13 | 108 | 0.8 | (0) | 0.38 | 0.12 | 1.9 | 0 |
| 31 | Broiled or fried, drained | 13.0 | 607 | 25.0 | 55.0 | 1.0 | 0 | 6.0 | 25 | 255 | 3.3 | (0) | 0.48 | 0.31 | 4.8 | 0 |
| 32 | Bacon, canned | 15.6 | 692 | 8.7 | 72.4 | 0.6 | 0 | 2.7 | 15 | 94 | 1.4 | (0) | 0.24 | 0.10 | 1.5 | 0 |
| 33 | Bacon, Canadian, raw | 56.0 | 231 | 22.1 | 15.0 | (0.3) | 0 | 6.2 | 13 | 210 | 3.3 | (0) | 0.91 | 0.25 | 5.2 | 0 |
| 34 | Bananas, raw | 74.8 | 88 | 1.2 | 0.2 | 23.0 | 0.6 | 0.8 | 8 | 28 | 0.6 | 430 | 0.04 | 0.05 | 0.7 | 10 |
| | Bananas, baking See *Plantain* | | | | | | | | | | | | | | | |
| • 35 | Barley, pearled, light dry | 11.1 | 349 | 8.2 | 1.0 | 78.8 | 0.5 | 0.9 | 16 | 189 | (2.0) | (0) | 0.12 | 0.08 | 3.1 | 0 |
| | Beans, common or kidney, mature dry seeds | | | | | | | | | | | | | | | |
| 36 | Pinto and red Mexican, raw | 8.1 | 349 | 23.0 | 1.2 | 63.7 | 3.9 | 4.0 | 163 | 437 | 6.9 | 0 | 0.65 | 0.24 | 2.0 | 2 |
| | Red kidney | | | | | | | | | | | | | | | |
| 37 | Raw | 12.2 | 336 | 23.1 | 1.7 | 59.4 | 3.5 | 3.6 | 163 | 437 | 6.9 | (0) | 0.57 | 0.22 | 2.5 | 2 |
| 38 | Canned (or cooked), solids and liquid | 76.0 | 90 | 5.7 | 0.4 | 16.4 | 0.9 | 1.5 | 40 | 124 | 1.9 | (0) | 0.05 | 0.05 | 0.8 | 0 |
| | Other (including navy, pea bean, white marrow, other) | | | | | | | | | | | | | | | |
| 39 | Raw | 11.5 | 338 | 21.4 | 1.6 | 61.6 | 4.0 | 3.9 | 163 | 437 | 6.9 | 0 | 0.67 | 0.23 | 2.2 | 2 |
| | Canned, baked | | | | | | | | | | | | | | | |
| 40 | Pork and molasses | 70.0 | 125 | 5.8 | 3.0 | 19.2 | 0.9 | 2.0 | 56 | 113 | 2.1 | 30 | 0.05 | 0.04 | 0.5 | 2 |
| 41 | Pork and tomato sauce | 71.7 | 113 | 5.8 | 2.1 | 18.4 | 1.0 | 2.0 | 41 | 113 | 1.8 | 80 | 0.05 | 0.04 | 0.5 | 2 |
| | *Beans, lima* | | | | | | | | | | | | | | | |
| | Immature seeds | | | | | | | | | | | | | | | |
| 42 | Raw | 66.5 | 128 | 7.5 | 0.8 | 23.5 | 1.5 | 1.7 | 63 | 158 | 2.3 | 280 | 0.21 | 0.11 | 1.4 | 32 |
| 43 | Cooked | 74.9 | 95 | 5.0 | 0.4 | 18.3 | 2.0 | 1.4 | 29 | 77 | 1.7 | 290 | 0.14 | 0.09 | 1.1 | 15 |
| | Canned | | | | | | | | | | | | | | | |
| 44 | Solids and liquid | 80.9 | 71 | 3.8 | 0.3 | 13.5 | 1.3 | 1.5 | 27 | 73 | 1.7 | 130 | 0.04 | 0.04 | 0.5 | 8 |
| 45 | Drained solids | 74.9 | 95 | 5.0 | 0.4 | 18.3 | 2.0 | 1.4 | 29 | 77 | 1.7 | 180 | 0.03 | 0.05 | 0.5 | 6 |
| 46 | Frozen | 71.6 | *109* | 6.4 | 0.7 | 19.9 | 1.3 | 1.4 | 53 | 134 | 1.9 | 220 | 0.10 | 0.07 | 0.8 | 17 |
| 47 | Mature dry seeds | 12.6 | 333 | 20.7 | 1.3 | 61.6 | 4.3 | 3.8 | 68 | 381 | 7.5 | 0 | 0.48 | 0.18 | 2.0 | 2 |
| | Beans, snap | | | | | | | | | | | | | | | |
| | Green | | | | | | | | | | | | | | | |
| 48 | Raw | 88.9 | 35 | 2.4 | 0.2 | 7.7 | 1.4 | 0.8 | 65 | 44 | 1.1 | 630 | 0.08 | 0.11 | 0.5 | 19 |

** From Composition of Foods—Raw, Processed, Prepared, Agriculture Handbook No 8, U S Dept Agriculture
* *Indicates values calculated from a recipe, parentheses indicate imputed value*
† Data on proximate constituents apply to Fuerte variety

**Table 144 Composition of Foods, 100 Grams, Edible Portion (Continued)**

| | Food and Description | Water (%) | Food Energy (Cal) | Protein (Gm) | Fat (Gm) | Carbohydrate (Gm) | | Ash (Gm) | Calcium (Mg) | Phosphorus (Mg) | Iron (Mg) | Vitamin A Value (IU) | Thiamine (Mg) | Riboflavin (Mg) | Niacin (Mg) | Ascorbic Acid (Mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Total | Fiber | | | | | | | | | |
| | Beans snap (Continued) | | | | | | | | | | | | | | | |
| 49 | Cooked (small amount of water, short time) | 92.5 | 22 | 1.4 | 0.2 | 4.7 | 0.5 | 1.2 | 36 | 23 | 0.7 | 660 | 0.07 | 0.10 | 0.5 | 14 |
| 50 | Cooked (large amount of water, long time) | 92.5 | 22 | 1.4 | 0.2 | 4.7 | 0.5 | 1.2 | 36 | 23 | 0.7 | 660 | 0.05 | 0.09 | 0.4 | 10 |
| | Canned | | | | | | | | | | | | | | | |
| 51 | Solids and liquid | 93.5 | 18 | 1.0 | 0.1 | 4.2 | 0.6 | 1.2 | 27 | 19 | 1.4 | 410 | 0.03 | 0.04 | 0.3 | 4 |
| 52 | Drained solids | 92.5 | 22 | 1.4 | 0.2 | 4.7 | 0.5 | 1.2 | 36 | 23 | 1.7 | 500 | 0.04 | 0.05 | 0.4 | 5 |
| 53 | Strained (infant food) | 92.6 | 22 | 1.8 | 0.1 | 4.6 | 1.1 | 0.9 | 33 | 25 | 0.6 | 490 | 0.03 | 0.07 | 0.3 | 5 |
| 54 | Frozen | 88.9 | 35 | 2.4 | 0.2 | 7.7 | 1.4 | 0.8 | 65 | 44 | 1.1 | 450 | 0.07 | 0.10 | 0.6 | 11 |
| | Wax or yellow | | | | | | | | | | | | | | | |
| 55 | Raw | 88.9 | 35 | 2.4 | 0.2 | 7.7 | 1.4 | 0.8 | 65 | 44 | 1.1 | 150 | 0.08 | 0.11 | 0.5 | 19 |
| | Canned | | | | | | | | | | | | | | | |
| 56 | Solids and liquid | 93.5 | 18 | 1.0 | 0.1 | 4.2 | 0.6 | 1.2 | 27 | 19 | 1.4 | 100 | 0.03 | 0.04 | 0.3 | 4 |
| 57 | Drained solids | 92.5 | 22 | 1.4 | 0.2 | 4.7 | 0.5 | 1.2 | 36 | 23 | 1.7 | 120 | 0.04 | 0.05 | 0.4 | 5 |
| | Beans, soya See *Soybeans* | | | | | | | | | | | | | | | |
| | Bean soup See *Soups* | | | | | | | | | | | | | | | |
| | Bean sprouts, raw See *Mung bean* and *Soybean sprouts* | | | | | | | | | | | | | | | |
| | Beef carcass, raw | | | | | | | | | | | | | | | |
| | Side including kidney fat | | | | | | | | | | | | | | | |
| 58 | Thin | 66.0 | 207 | 18.8 | 14.0 | 0 | 0 | 1.0 | 11 | 170 | 2.8 | (0) | 0.08 | 0.17 | 4.5 | 0 |
| 59 | Medium fat | 60.0 | 273 | 17.5 | 22.0 | 0 | 0 | 0.9 | 10 | 150 | 2.6 | (0) | 0.08 | 0.16 | 4.2 | 0 |
| 60 | Fat | 55.0 | 322 | 16.3 | 28.0 | 0 | 0 | 0.8 | 9 | 132 | 2.4 | (0) | 0.07 | 0.15 | 3.9 | 0 |
| 61 | Very fat | 47.0 | 410 | 13.7 | 39.0 | 0 | 0 | 0.7 | 8 | 94 | 2.1 | (0) | 0.06 | 0.12 | 3.3 | 0 |
| 62 | Medium fat carcass, trimmed to retail | 63.0 | 240 | 18.2 | 18.0 | 0 | 0 | 0.9 | 11 | 161 | 2.7 | (0) | 0.08 | 0.16 | 4.4 | 0 |
| | Beef cuts, medium fat | | | | | | | | | | | | | | | |
| | Chuck | | | | | | | | | | | | | | | |
| 63 | Raw | 65.0 | 224 | 18.6 | 16.0 | 0 | 0 | 0.9 | 11 | 167 | 2.8 | (0) | 0.08 | 0.17 | 4.5 | 0 |
| 64 | Cooked | 51.0 | 309 | 26.0 | 22.0 | 0 | 0 | 0.7 | 11 | 117 | 3.1 | (0) | 0.05† | 0.20† | 4.1† | 0 |
| | Flank | | | | | | | | | | | | | | | |
| 65 | Raw | 61.0 | 247 | 19.9 | 18.0 | 0 | 0 | 0.9 | 12 | 186 | 3.0 | (0) | 0.09 | 0.18 | 4.8 | 0 |
| 66 | Cooked | 51.0 | 314 | 25.0 | 23.0 | 0 | 0 | 0.6 | 11 | 117 | 3.0 | (0) | 0.05† | 0.20† | 4.1† | 0 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Hamburger | | | | | | | | | | | | | | | |
| 67 | Raw | 55.0 | 321 | 16.0 | 28.0 | 0 | 0 | 0.8 | 9 | 128 | 2.4 | (0) | 0.07 | 0.14 | 3.8 | 0 |
| 68 | Cooked | 47.0 | 364 | 22.0 | 30.0 | 0 | 0 | 1.1 | 9 | 158 | 2.8 | (0) | 0.08 | 0.19 | 4.8 | 0 |
| | Lean See *Round* | | | | | | | | | | | | | | | |
| | Porterhouse | | | | | | | | | | | | | | | |
| 69 | Raw | 58.0 | 296 | 16.4 | 25.0 | 0 | 0 | 0.8 | 10 | 134 | 2.5 | (0) | 0.07 | 0.15 | 3.9 | 0 |
| 70 | Cooked | 49.0 | 342 | 23.0 | 27.0 | 0 | 0 | 1.1 | 11 | 170 | 3.0 | (0) | 0.06 | 0.18 | 4.7 | 0 |
| | Rib roast | | | | | | | | | | | | | | | |
| 71 | Raw | 59.0 | 282 | 17.4 | 23.0 | 0 | 0 | 0.8 | 10 | 149 | 2.6 | (0) | 0.07 | 0.15 | 4.2 | 0 |
| 72 | Cooked | 51.0 | 319 | 24.0 | 24.0 | 0 | 0 | 1.2 | 10 | 185 | 3.0 | (0) | 0.06 | 0.18 | 4.3 | 0 |
| | Round | | | | | | | | | | | | | | | |
| 73 | Raw | 69.0 | 182 | 19.5 | 11.0 | 0 | 0 | 1.0 | 11 | 180 | 2.9 | (0) | 0.08 | 0.17 | 4.7 | 0 |
| 74 | Cooked | 59.0 | 233 | 27.0 | 13.0 | 0 | 0 | 1.3 | 11 | 224 | 3.4 | (0) | 0.08 | 0.22 | 5.5 | 0 |
| | Rump | | | | | | | | | | | | | | | |
| 75 | Raw | 55.0 | 322 | 16.2 | 28.0 | 0 | 0 | 0.8 | 9 | 131 | 2.4 | (0) | 0.07 | 0.14 | 3.9 | 0 |
| 76 | Cooked | 46.0 | 378 | 21.0 | 32.0 | 0 | 0 | 0.5 | 8 | 85 | 2.5 | (0) | 0.04† | 0.15† | 3.1† | 0 |
| | Sirloin | | | | | | | | | | | | | | | |
| 77 | Raw | 62.0 | 254 | 17.3 | 20.0 | 0 | 0 | 0.9 | 10 | 147 | 2.6 | (0) | 0.07 | 0.15 | 4.2 | 0 |
| 78 | Cooked | 54.0 | 297 | 23.0 | 22.0 | 0 | 0 | 1.1 | 10 | 175 | 2.9 | (0) | 0.06 | 0.19 | 4.8 | 0 |
| | Beef, canned | | | | | | | | | | | | | | | |
| 79 | Corned beef hash | 70.4 | 141 | 13.7 | 6.1 | 7.2 | 0.2 | 2.6 | 26 | 146 | 1.3 | Trace | 0.03 | 0.14 | 2.9 | 0 |
| 80 | Roast beef | 60.0 | 224 | 25.0 | 13.0 | 0 | 0 | 2.0 | 16 | 116 | 2.4 | (0) | 0.02 | 0.23 | 4.2 | 0 |
| 81 | Strained (infant food) | 77.9 | 105 | 17.4 | 3.4 | 0 | 0 | 1.3 | 11 | 150 | 4.2 | (0) | 0.01 | 0.22 | 3.3 | 0 |
| | *Beef, corned, boneless* | | | | | | | | | | | | | | | |
| 82 | Uncooked, medium fat | 54.2 | 293 | 15.8 | 25.0 | 0 | 0 | 5.0 | 9 | 125 | 2.4 | (0) | 0.03 | 0.15 | 1.7 | 0 |
| | Canned | | | | | | | | | | | | | | | |
| 83 | Lean | 62.0 | 185 | 26.4 | 8.0 | 0 | 0 | 3.6 | 21 | 110 | 4.5 | (0) | 0.02 | 0.25 | 3.5 | 0 |
| 84 | Medium fat | 59.3 | 216 | 25.3 | 12.0 | 0 | 0 | 3.4 | 20 | 106 | 4.3 | (0) | 0.02 | 0.24 | 3.4 | 0 |
| 85 | Fat | 55.3 | 263 | 23.5 | 18.0 | 0 | 0 | 3.2 | 19 | 98 | 4.0 | (0) | 0.01 | 0.22 | 3.2 | 0 |
| 86 | Beef dried or chipped | 47.7 | 203 | 34.3 | 6.3 | 0 | 0 | 11.6 | 20 | 404 | 5.1 | (0) | (0.07) | (0.32) | (3.8) | 0 |
| 87 | *Beef and vegetable stew | 78.6 | 107 | 5.5 | 8.2 | 7.1 | 0.4 | 0.6 | 13 | 75 | 1.1 | 1070 | 0.05 | 0.06 | 1.5 | 6 |
| 88 | Beer (average, 4 per cent alcohol) | 90.2 | ‡ | 0.6 | 0.0 | 4.4 | | 0.2 | 4 | 26 | 0.0 | (0) | Trace | 0.03 | 0.2 | (0) |
| | Beets, common red | | | | | | | | | | | | | | | |
| 89 | Raw, peeled root | 87.6 | 42 | 1.6 | 0.1 | 9.6 | 0.9 | 1.1 | 27 | 43 | 1.0 | 20 | 0.02 | 0.05 | 0.4 | 10 |
| 90 | Cooked | 88.3 | 41 | 1.0 | 0.1 | 9.8 | 0.8 | 0.8 | 21 | 31 | 0.7 | 20 | 0.02 | 0.04 | 0.3 | 7 |
| | Canned | | | | | | | | | | | | | | | |
| 91 | Solids and liquid | 90.3 | 34 | 0.9 | 0.1 | 7.9 | 0.5 | 0.8 | 15 | 29 | 0.6 | 20 | 0.01 | 0.02 | 0.1 | 5 |
| 92 | Drained solids | 88.3 | 41 | 1.0 | 0.1 | 9.8 | 0.8 | 0.8 | 21 | 31 | 0.7 | 20 | 0.01 | 0.03 | 0.1 | 5 |
| 93 | Strained (infant food) | 89.6 | 34 | 1.4 | 0.1 | 7.7 | 0.6 | 1.2 | 18 | 26 | 0.8 | 10 | 0.01 | 0.03 | 0.2 | 6 |

* Indicates values calculated from a recipe parentheses indicate imputed value

† Data assume cut to be prepared by braising or pot roasting Use of proportionate quantity of drippings would add approximately 50 per cent more thiamine and niacin and 25 per cent more riboflavin

‡ The value excluding energy derived from alcohol is 20 Calories If the energy from alcohol is considered available, the value is 48 Calories

**Table 144 Composition of Foods, 100 Grams, Edible Portion (Continued)**

| | Food and Description | Water (%) | Food Energy (Cal) | Protein (Gm) | Fat (Gm) | Carbohydrate (Gm) Total | Carbohydrate (Gm) Fiber | Ash (Gm) | Calcium (Mg) | Phosphorus (Mg) | Iron (Mg) | Vitamin A Value (I U) | Thiamine (Mg) | Riboflavin (Mg) | Niacin (Mg) | Ascorbic Acid (Mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Beet greens common | | | | | | | | | | | | | | | |
| 94 | Raw | 90.4 | 27 | 2.0 | 0.3 | 5.6 | 1.4 | 1.7 | 118‡ | 45 | 3.2 | 6700 | 0.08 | 0.18 | 0.4 | 34 |
| 95 | Cooked | 90.4 | 27 | 2.0 | 0.3 | 5.6 | 1.4 | 1.7 | 118‡ | 45 | 3.2 | 7440 | 0.05 | 0.16 | 0.4 | 15 |
| | Beverages carbonated | | | | | | | | | | | | | | | |
| 96 | Ginger ale | 91.0 | 35 | | | 9.0 | | | | | | | | | | |
| 97 | Other including kola type | 88.0 | 46 | | | 12.0 | | | | | | | | | | |
| | *Biscuits, baking powder made with | | | | | | | | | | | | | | | |
| 98 | Unenriched flour | 27.0 | 342 | 8.2 | 10.6 | 52.2 | 0.2 | 2.0 | 218 | 193 | 0.5 | 0 | 0.05 | 0.09 | 0.5 | 0 |
| 99 | Enriched flour | 27.0 | 342 | 8.2 | 10.6 | 52.2 | 0.2 | 2.0 | 218 | 193 | 1.8 | 0 | 0.23 | 0.22 | 2.0 | 0 |
| 100 | Enriched self rising flour | 28.0 | 334 | 8.0 | 10.9 | 49.9 | 0.2 | 3.2 | 220 | 250 | 1.8 | 0 | 0.24 | 0.23 | 2.0 | 0 |
| 101 | *Biscuits canned unbaked | 38.6 | 287 | 6.9 | 8.9 | 43.9 | 0.2 | 1.7 | 184 | 163 | 1.5 | 0 | 0.24 | 0.20 | 1.8 | 0 |
| | Blackberries | | | | | | | | | | | | | | | |
| 102 | Raw | 84.8 | 57 | 1.2 | 1.0 | 12.5 | 4.2 | 0.5 | 32 | 32 | 0.9 | 200 | 0.04 | 0.04 | 0.4 | 21 |
| | Canned solids and liquids | | | | | | | | | | | | | | | |
| 103 | Water pack | 88.7 | 43 | 0.9 | 0.7 | 9.4 | 2.0 | 0.3 | 18 | 19 | (0.7) | 180 | 0.01 | 0.02 | 0.2 | 6 |
| 104 | Sirup pack | 76.0 | 86 | 0.7 | 0.2 | 22.8 | 2.9 | 0.3 | 18 | 19 | (0.7) | 180 | 0.01 | 0.02 | 0.2 | 6 |
| | Black-eyed peas See *Cowpeas* | | | | | | | | | | | | | | | |
| 105 | *Blanc mange (vanilla cornstarch pudding) | 76.0 | 111 | 3.5 | 3.9 | 15.7 | 0 | 0.9 | 117 | 92 | 0.1 | 160 | 0.03 | 0.16 | 0.1 | Trace |
| | Blueberries | | | | | | | | | | | | | | | |
| 106 | Raw | 83.4 | 61 | 0.6 | 0.6 | 15.1 | 1.2 | 0.3 | 16 | 13 | 0.8 | 280 | (0.02) | (0.02) | (0.3) | 16 |
| | Canned solids and liquid | | | | | | | | | | | | | | | |
| 107 | Water pack | 90.0 | 37 | 0.4 | 0.4 | 9.0 | 1.0 | 0.2 | 11 | 6 | (0.5) | 40 | 0.01 | 0.01 | 0.2 | 13 |
| 108 | Sirup pack | 73.0 | 98 | 0.4 | 0.4 | 26.0 | 1.0 | 0.2 | 11 | 6 | (0.5) | 40 | 0.01 | 0.01 | 0.2 | 13 |
| 109 | Frozen, without sugar | 83.4 | 61 | 0.6 | 0.6 | 15.1 | 1.2 | 0.3 | 16 | 13 | 0.8 | 240 | (0.02) | (0.02) | (0.3) | 14 |
| | Bluefish | | | | | | | | | | | | | | | |
| 110 | Raw | 74.6 | 124 | 20.5 | 4.0 | 0 | 0 | 1.2 | 23 | 243 | 0.6 | | (0.12) | (0.09) | 1.9 | |
| 111 | Cooked baked | 69.2 | 155 | 27.4 | 4.2 | 0 | 0 | 1.9 | 23 | 293 | 0.7 | | 0.12 | 0.11 | 2.2 | |
| 112 | Cooked fried | 60.8 | 205 | 22.7 | 9.8 | 4.7 | 0 | 2.0 | 19 | 243 | 0.6 | | 0.11 | 0.11 | 2.1 | |
| | Bologna See *Sausage* | | | | | | | | | | | | | | | |
| | Boston brown bread See *Breads* | | | | | | | | | | | | | | | |
| 113 | Bouillon cubes | 5.0 | 48 | (6.0) | 2.5 | (0) | 0 | 68.0 | | | | | | 1.8 | 25.6 | 0 |
| 114 | Brains all kinds raw | 78.9 | 125 | 10.4 | 8.6 | 0.8 | 0 | 1.4 | 16 | 330 | 3.6 | 0 | 0.23 | 0.26 | 4.4 | 18 |
| 115 | Bran (breakfast cereal, almost wholly bran) | 2.6 | 242 | 12.0 | 3.4 | 74.2 | 8.8 | 7.8 | 94 | 1312 | 10.3 | (0) | 0.37 | 0.39 | 19.2 | (0) |
| 116 | Bran flakes (40 per cent bran) | 3.6 | 292 | 10.8 | 1.9 | 78.8 | 3.9 | 4.9 | 61 | 622 | 5.1 | (0) | 0.46 | 0.23 | 8.7 | (0) |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 117 | Bran, raisin | 6.4 | 297 | 9.0 | 1.8 | 78.6 | 3.5 | 4.2 | 60 | 541 | 4.8 | (0) | 0.39 | 0.19 | 7.0 | (0) |
| 118 | Brazil nuts | 5.3 | 646 | 14.4 | 65.9 | 11.0 | 2.1 | 3.4 | 186 | 693 | 3.4 | Trace | 0.86 | | | |
| | *Breads | | | | | | | | | | | | | | | |
| | Boston brown bread made with degermed corn meal | | | | | | | | | | | | | | | |
| 119 | Unenriched | 44.5 | 219 | 4.8 | 2.1 | 46.0 | 0.3 | 2.6 | 185 | 158 | 2.5 | 140 | 0.08 | 0.12 | 1.4 | 0 |
| 120 | Enriched | 44.5 | 219 | 4.8 | 2.1 | 46.0 | 0.3 | 2.6 | 185 | 158 | 2.9 | 140 | 0.13 | 0.17 | 1.9 | 0 |
| | *Cracked wheat bread, made with* | | | | | | | | | | | | | | | |
| 121 | Unenriched flour | 36.0 | 259 | 8.5 | 2.2 | 51.4 | 0.5 | 1.9 | 83 | 126 | 1.0 | 0 | 0.11 | 0.10 | 1.4 | 0 |
| 122 | Toasted | 26.0 | 299 | 9.8 | 2.5 | 59.5 | 0.6 | 2.2 | 96 | 146 | 1.2 | 0 | 0.10 | 0.11 | 1.6 | 0 |
| 123 | Enriched flour | 36.0 | 259 | 8.5 | 2.2 | 51.4 | 0.5 | 1.9 | 83 | 126 | 2.0 | 0 | 0.25 | 0.19 | 2.5 | 0 |
| 124 | Toasted | 26.0 | 299 | 9.8 | 2.5 | 59.5 | 0.6 | 2.2 | 96 | 146 | 2.3 | 0 | 0.23 | 0.22 | 2.9 | 0 |
| | French or Vienna breads | | | | | | | | | | | | | | | |
| 125 | Unenriched | 35.5 | 270 | 8.1 | 2.7 | 52.0 | 0.2 | 1.7 | 24 | 71 | 0.7 | 0 | 0.05 | 0.06 | 0.9 | 0 |
| 126 | Enriched | 35.5 | 270 | 8.1 | 2.7 | 52.0 | 0.2 | 1.7 | 24 | 71 | 1.8† | 0 | 0.24† | 0.15† | 2.2† | 0 |
| | Italian bread | | | | | | | | | | | | | | | |
| 127 | Unenriched | 35.0 | 263 | 8.7 | 0.8 | 53.7 | 0.2 | 1.8 | 13 | 77 | 0.7 | 0 | 0.05 | 0.07 | 1.0 | 0 |
| 128 | Enriched | 35.0 | 263 | 8.7 | 0.8 | 53.7 | 0.2 | 1.8 | 13 | 77 | 1.8† | 0 | 0.24† | 0.15† | 2.2† | 0 |
| | Raisin bread | | | | | | | | | | | | | | | |
| 129 | Unenriched | 30.2 | 284 | 7.1 | 3.1 | 57.8 | 0.2 | 1.8 | 80 | 104 | 1.3 | 10 | 0.07 | 0.11 | 0.9 | 0 |
| 130 | Toasted | 22.0 | 318 | 7.9 | 3.5 | 64.6 | 0.2 | 2.0 | 89 | 116 | 1.5 | 10 | 0.06 | 0.12 | 1.0 | 0 |
| 131 | Enriched | 30.2 | 284 | 7.1 | 3.1 | 57.8 | 0.2 | 1.8 | 80 | 104 | 1.8† | 10 | 0.24† | 0.15† | 2.2† | 0 |
| 132 | Toasted | 22.0 | 318 | 7.9 | 3.5 | 64.6 | 0.2 | 2.0 | 89 | 116 | 2.0 | 10 | 0.22 | 0.17 | 2.5 | 0 |
| 133 | Rye bread, American (⅓ rye, ⅔ clear flour) | 35.3 | 244 | 9.1 | 1.2 | 52.4 | 0.4 | 2.0 | 72 | 147 | 1.6 | 0 | 0.18 | 0.08 | 1.5 | 0 |
| | White bread, unenriched | | | | | | | | | | | | | | | |
| 134 | 2 per cent nonfat milk solids | 34.5 | 276 | 8.2 | 3.3 | 52.3 | 0.2 | 1.7 | 65 | 81 | 0.6 | 0 | 0.05 | 0.08 | 0.9 | 0 |
| 135 | 4 per cent nonfat milk solids‡ | 34.7 | 275 | 8.5 | 3.2 | 51.8 | 0.2 | 1.8 | 79 | 92 | 0.6 | 0 | 0.05 | 0.11 | 0.9 | 0 |
| 136 | Toasted | 25.5 | 313 | 9.7 | 3.7 | 59.0 | 0.2 | 2.1 | 90 | 105 | 0.7 | 0 | 0.05 | 0.12 | 1.0 | 0 |
| 137 | 6 per cent nonfat milk solids | 34.2 | 276 | 8.6 | 3.1 | 52.3 | 0.2 | 1.8 | 92 | 101 | 0.6 | 0 | 0.05 | 0.12 | 0.9 | 0 |
| | White bread, enriched | | | | | | | | | | | | | | | |
| 138 | 2 per cent nonfat milk solids | 34.5 | 276 | 8.2 | 3.3 | 52.3 | 0.2 | 1.7 | 65 | 81 | 1.8† | 0 | 0.24† | 0.15† | 2.2† | 0 |
| 139 | 4 per cent nonfat milk solids‡ | 34.7 | 275 | 8.5 | 3.2 | 51.8 | 0.2 | 1.8 | 79 | 92 | 1.8† | 0 | 0.24† | 0.15† | 2.2† | 0 |
| 140 | Toasted | 25.5 | 313 | 9.7 | 3.7 | 59.0 | 0.2 | 2.1 | 90 | 105 | 2.1 | 0 | 0.22 | 0.18 | 2.5 | 0 |
| 141 | 6 per cent nonfat milk solids | 34.2 | 276 | 8.6 | 3.1 | 52.3 | 0.2 | 1.8 | 92 | 101 | 1.8† | 0 | 0.24† | 0.15† | 2.2† | 0 |
| 142 | Whole wheat bread | 36.6 | 240 | 9.3 | 2.6 | 49.0 | 1.5 | 2.5 | 96 | 263 | 2.2 | 0 | 0.30 | 0.13 | 3.0 | 0 |

* Indicates values calculated from a recipe, parentheses indicate imputed value

† Iron, thiamine, riboflavin and niacin are based on the minimum level of enrichment specified in standards of identity proposed by the Federal Security Agency and published in the Federal Register, August 3, 1943

‡ When the amount of nonfat milk solids in commercial bread is unknown, use bread with 4 per cent nonfat milk solids, item 135 for unenriched bread and 139 for enriched

§ Calcium may not be available because of presence of oxalic acid

**Table 144. Composition of Foods, 100 Grams, Edible Portion (Continued)**

| No. | Food and Description | Water (%) | Food Energy (Cal) | Protein (Gm) | Fat (Gm) | Carbohydrate (Gm) Total | Carbohydrate (Gm) Fiber | Ash (Gm) | Calcium (Mg) | Phosphorus (Mg) | Iron (Mg) | Vitamin A Value (I U) | Thiamine (Mg) | Riboflavin (Mg) | Niacin (Mg) | Ascorbic Acid (Mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Whole wheat bread (Continued) | | | | | | | | | | | | | | | |
| 143 | Toasted | 26.0 | 280 | 10.9 | 3.0 | 57.2 | 1.8 | 2.9 | 112 | 307 | 2.6 | 0 | 0.28 | 0.15 | 3.5 | 0 |
| | See also *Biscuits, Corn bread, Muffins, Rolls* | | | | | | | | | | | | | | | |
| 144 | Bread crumbs, dry, grated | 8.5 | 385 | 11.9 | 4.5 | 72.5 | 0.2 | 2.6 | 111 | 129 | 2.6 | 0 | 0.27 | 0.22 | 3.1 | 0 |
| | Breakfast foods, mixed cereals | | | | | | | | | | | | | | | |
| 145 | Corn and soy grits, ready to eat (added thiamine and niacin) | 2.7 | 353 | 18.0 | 0.3 | 75.1 | 1.2 | 3.9 | 66 | 182 | 6.3 | (0) | 0.67 | 0.12 | 2.1 | (0) |
| 146 | Wheat and malted barley, ready to-eat (added thiamine and niacin) | 2.8 | 361 | 11.0 | 0.6 | 82.8 | 1.8 | 2.8 | 47 | 330 | 3.5 | (0) | 0.53 | 0.17 | 4.7 | (0) |
| | Breakfast foods See individual grain as *Corn Oatmeal*, etc | | | | | | | | | | | | | | | |
| | Broccoli, flower stalks | | | | | | | | | | | | | | | |
| 147 | Raw | 89.9 | 29 | 3.3 | 0.2 | 5.5 | 1.3 | 1.1 | 130 | 76 | 1.3 | 3500 | 0.10 | 0.21 | 1.1 | 118 |
| 148 | Cooked | 89.9 | 29 | 3.3 | 0.2 | 5.5 | 1.3 | 1.1 | 130 | 76 | 1.3 | 3400 | 0.07 | 0.15 | 0.8 | 74 |
| 149 | Frozen | 92.2 | 23 | 2.5 | 0.2 | 4.3 | 1.0 | 0.8 | 100 | 59 | 1.0 | 2330 | 0.07 | 0.12 | 0.9 | 75 |
| | Brown betty See *Apple betty* | | | | | | | | | | | | | | | |
| | Brussels sprouts | | | | | | | | | | | | | | | |
| 150 | Raw | 84.9 | 47 | 4.4 | 0.5 | 8.9 | 1.3 | 1.3 | 34 | 78 | 1.3 | 400 | 0.08 | 0.16 | 0.7 | 94 |
| 151 | Cooked | 84.9 | 47 | 4.4 | 0.5 | 8.9 | 1.3 | 1.3 | 34 | 78 | 1.3 | 400 | 0.04 | 0.12 | 0.5 | 47 |
| 152 | Frozen | 84.9 | 47 | 4.4 | 0.5 | 8.9 | 1.3 | 1.3 | 34 | 78 | 1.3 | 340 | 0.05 | 0.14 | 0.6 | 63 |
| | Buckwheat flour | | | | | | | | | | | | | | | |
| 153 | Dark | 12.0 | 332 | 11.7 | 2.5 | 72.0 | 1.6 | 1.8 | 33 | 347 | 2.8 | (0) | 0.58 | 0.15 | 2.9 | (0) |
| 154 | Light | 12.0 | 347 | 6.4 | 1.2 | 79.5 | 0.5 | 0.9 | 11 | 88 | 1.0 | (0) | 0.08 | (0.04) | (0.4) | (0) |
| | Buckwheat pancake mix See *Pancake mix* | | | | | | | | | | | | | | | |
| 155 | Butter | 15.5 | 716 | 0.6 | 81.0 | 0.4 | 0 | 2.5 | 20 | 16 | 0.0 | 3300† | | | | 0 |
| 156 | Buttermilk, cultured (made from skim milk) | 90.5 | 36 | 3.5 | 0.1 | 5.1 | 0 | 0.8 | (118) | 93 | 0.1 | Trace | 0.04 | 0.18 | 0.1 | 1 |
| | Cabbage | | | | | | | | | | | | | | | |
| 157 | Raw | 92.4 | 24 | 1.4 | 0.2 | 5.3 | 1.0 | 0.8 | 46 | 31 | 0.5 | 80 | 0.06 | 0.05 | 0.3 | 50 |
| 158 | Cooked (small amount of water, short time) | 92.4 | 24 | 1.4 | 0.2 | 5.3 | 1.0 | 0.8 | 46 | 31 | 0.5 | 90 | 0.05 | 0.05 | 0.3 | 31 |
| 159 | Cooked (large amount of water long time) | 92.4 | 24 | 1.4 | 0.2 | 5.3 | 1.0 | 0.8 | 46 | 31 | 0.5 | 90 | 0.03 | 0.03 | 0.2 | 19 |
| 160 | Dehydrated unsulfited‡ | 4.0 | 310 | 14.4 | 1.9 | 72.5 | 11.1 | 7.2 | 394 | 288 | 4.9 | 540 | 0.53 | 0.38 | 2.9 | 218 |
| | Cabbage salad See *Coleslaw* | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cabbage celery or Chinese | | | | | | | | | | | | | | | |
| 161 | Raw | 95.4 | 14 | 1.2 | 0.3 | 2.4 | 0.5 | 0.7 | 43 | 41 | 0.9 | 260 | 0.03 | 0.04 | 0.4 | 31 |
| 162 | Cooked | 95.4 | 14 | 1.2 | 0.3 | 2.4 | 0.5 | 0.7 | 43 | 41 | 0.9 | 260 | 0.02 | 0.03 | 0.3 | 22 |
| | *Cakes | | | | | | | | | | | | | | | |
| 163 | Angel food | 31.6 | 270 | 8.4 | 0.3 | 58.7 | 0 | 1.0 | 6 | 24 | 0.3 | (0) | 0.01 | 0.14 | 0.2 | (0) |
| 164 | Foundation | 25.1 | 350 | 5.9 | 11.7 | 55.9 | 0.1 | 1.4 | 126 | 120 | 0.5 | 160§ | 0.03 | 0.08 | 0.2 | (0) |
| 165 | Foundation, plain icing | 24.1 | 342 | 5.0 | 9.3 | 60.4 | 0.1 | 1.2 | 101 | 96 | 0.4 | 120§ | 0.02 | 0.07 | 0.2 | (0) |
| 166 | Foundation, fudge icing | 24.4 | 349 | 4.4 | 11.5 | 58.5 | 0.2 | 1.2 | 98 | 101 | 0.4 | 120§ | 0.02 | 0.08 | 0.2 | (0) |
| 167 | Fruit, dark | 22.9 | 354 | 5.2 | 13.8 | 55.9 | 1.2 | 2.2 | 97 | 126 | 2.8 | 160§ | 0.14 | 0.14 | 1.1 | (0) |
| 168 | Plain cake and cupcakes | 26.8 | 327 | 6.4 | 8.2 | 57.0 | 0.1 | 1.6 | 155 | 137 | 0.4 | 120§ | 0.03 | 0.08 | 0.3 | (0) |
| 169 | Plain cake and cupcakes, iced | 25.2 | 322 | 5.2 | 6.2 | 62.1 | 0.1 | 1.3 | 117 | 104 | 0.4 | 90§ | 0.02 | 0.07 | 0.2 | (0) |
| 170 | Pound | 19.3 | 434 | 7.1 | 23.5 | 49.3 | 0.1 | 0.8 | 52 | 104 | 1.6 | 330§ | 0.12 | 0.16 | 0.9 | (0) |
| 171 | Rich | 21.6 | 392 | 5.0 | 17.7 | 54.2 | 0.1 | 1.5 | 105 | 113 | 0.6 | 210§ | 0.03 | 0.08 | 0.2 | (0) |
| 172 | Rich, plain icing | 21.4 | 378 | 4.4 | 14.7 | 58.2 | 0 | 1.3 | 88 | 94 | 0.5 | 170§ | 0.02 | 0.07 | 0.2 | (0) |
| 173 | Sponge | 31.8 | 291 | 7.9 | 5.0 | 54.4 | 0.2 | 0.9 | 28 | 110 | 1.4 | 520§ | 0.05 | 0.15 | 0.2 | (0) |
| | Candy | | | | | | | | | | | | | | | |
| | Candied or glacé peel | | | | | | | | | | | | | | | |
| 174 | Citron | 18.0 | 314 | 0.2 | 0.3 | 80.2 | 1.4 | 1.3 | 83 | 24 | 0.8 | | | | | |
| 175 | Ginger root, crystallized | 12.0 | 340 | 0.3 | 0.2 | 87.1 | 0.7 | 0.4 | | | | | | | | |
| 176 | Lemon, orange, or grapefruit peel | 17.4 | 316 | 0.4 | 0.3 | 80.6 | 2.3 | 1.3 | | | | | | | | |
| 177 | *Butterscotch | 5.0 | 410 | 0 | 8.9 | 85.6 | 0 | 0.5 | 20 | 7 | 1.8 | (0) | (0) | Trace | Trace | (0) |
| 178 | *Caramels | 7.0 | 415 | 2.9 | 11.6 | 77.5 | 0 | 1.0 | 126 | 90 | 2.3 | 170 | 0.02 | 0.14 | 0.1 | Trace |
| 179 | Chocolate, sweetened, milk | 1.1 | 503 | (6.0) | 33.5 | 55.7 | 0.5 | 1.7 | 216 | 283 | 0.9 | 150 | 0.10 | 0.38 | 0.8 | (0) |
| 180 | Chocolate, sweetened, milk, with almonds | 0.6 | 532 | (8.0) | 38.6 | 50.0 | 0.6 | 1.8 | 206 | 249 | 2.1 | 140 | 0.13 | 0.51 | (1.1) | (0) |
| 181 | Chocolate creams | 9.0 | 394 | 4.0 | 14.0 | 72.0 | | 1.0 | | | | | | | | 0 |
| 182 | Fondant | 8.0 | 352 | 0 | 0 | 91.0 | 0 | 1.0 | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) |
| 183 | *Fudge, plain | 5.0 | 411 | 1.7 | 11.3 | 81.3 | 0.3 | 0.7 | 48/ | 67 | 0.5 | 220 | 0.01 | 0.07 | 0.1 | Trace |
| 184 | Hard | 1.0 | 383 | 0 | 0 | 99.0 | 0 | 0 | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) |
| 185 | Marshmallows | 15.0 | 325 | 3.0 | 0 | 81.0 | | 1.0 | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) |
| 186 | *Peanut brittle | 2.0 | 441 | 8.3 | 15.5 | 72.8 | 0.8 | 1.3 | 38 | 124 | 2.0 | 30 | 0.09 | 0.05 | 4.9 | 0 |
| 187 | Cantaloups, raw | 94.0 | 20 | 0.6 | 0.2 | 4.6 | 0.6 | 0.6 | 17 | 16 | 0.4 | 3420■ | 0.05 | 0.04 | 0.5 | 33 |
| | Carrots | | | | | | | | | | | | | | | |
| 188 | Raw | 88.2 | 42 | 1.2 | 0.3 | 9.3 | 1.1 | 1.0 | 39 | 37 | 0.8 | 12000 | 0.06 | 0.06 | 0.5 | |
| 189 | Cooked | 91.5 | 30 | 0.6 | 0.5 | 6.4 | 0.8 | 1.0 | 26 | 26 | 0.6 | 12500 | 0.05 | 0.05 | 0.4 | 4 |

* Indicates values calculated from a recipe parentheses indicate imputed value

† Year round average.

‡ If sulfited the *thiamine value would be much lower, and the ascorbic acid value would be about double*

§ If the fat used in the recipe is butter or fortified margarine the vitamin A value per 100 gm would be 540 I U in foundation cake, 430 I.U in foundation cake, iced, 410 I U in dark fruit cake 370 I U in plain cake, 280 I U in plain cake, iced 990 I U in pound cake, 830 I U in rich cake, and 690 I U in rich cake, iced

/ If the calcium contributed by chocolate is considered unavailable, the value would be 38 mg per 100 gm

■ Vitamin A based on deeply colored varieties

Table 144 Composition of Foods, 100 Grams, Edible Portion (Continued)

| | Food and Description | Water (%) | Food Energy (Cal) | Protein (Gm) | Fat (Gm) | Carbohydrate (Gm) | | Ash (Gm) | Calcium (Mg) | Phosphorus (Mg) | Iron (Mg) | Vitamin A Value (IU) | Thiamine (Mg) | Riboflavin (Mg) | Niacin (Mg) | Ascorbic Acid (Mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Total | Fiber | | | | | | | | | |
| | Carrots (Continued) | | | | | | | | | | | | | | | |
| | Canned | | | | | | | | | | | | | | | |
| 190 | Solids and liquid | 92 2 | 28 | 0 5 | 0 4 | 6 1 | 0 6 | 0 9 | 22 | 24 | 0 6 | 12000 | 0 02 | 0 02 | 0 3 | 2 |
| 191 | Drained solids | 91 5 | 30 | 0 6 | 0 5 | 6 4 | 0 8 | 1 0 | 26 | 26 | 0 6 | 17570 | 0 02 | 0 02 | 0 3 | 3 |
| 192 | Strained (infant food) | 92 0 | 26 | 1 1 | 0 1 | 5 9 | 0 9 | 0 9 | 25 | 23 | 0 6 | 8940 | 0 02 | 0 03 | 0 5 | 4 |
| 193 | Dehydrated | 4 0 | 347 | 4 1 | 1 4 | 84 5 | 9 7 | 6 0 | 246 | 104 | 2 3 | 114800 | 0 31 | 0 30 | 3 0 | 12 |
| 194 | Cashew nuts roasted or cooked | 3 6 | 578 | 18 5 | 48 2 | 27 0 | 1 3 | 2 7 | 46 | 428 | 5 0 | | 0 63 | 0 19 | 2 1 | |
| | Catsup, tomato See *Tomato catsup* | | | | | | | | | | | | | | | |
| | Cauliflower | | | | | | | | | | | | | | | |
| 195 | Raw | 91 7 | 25 | 2 4 | 0 2 | 4 9 | 0 9 | 0 8 | 22 | 72 | 1 1 | 90 | 0 11 | 0 10 | 0 6 | 69 |
| 196 | Cooked | 91 7 | 25 | 2 4 | 0 2 | 4 9 | 0 9 | 0 8 | 22 | 72 | 1 1 | 90 | 0 06 | 0 08 | 0 5 | 28 |
| 197 | Frozen | 91 7 | 25 | 2 4 | 0 2 | 4 9 | 0 9 | 0 8 | 22 | 72 | 1 1 | 80 | 0 09 | 0 08 | 0 5 | 51 |
| | Celery, bleached | | | | | | | | | | | | | | | |
| 198 | Raw | 93 7 | 18 | 1 3 | 0 2 | 3 7 | 0 7 | 1 1 | 50 | 40 | 0 5 | 0 | 0 05 | 0 04 | 0 4 | 7 |
| 199 | Cooked | 93 7 | 18 | 1 3 | 0 2 | 3 7 | 0 7 | 1 1 | 50 | 40 | 0 5 | 0 | 0 04 | 0 03 | 0 3 | 5 |
| | Cereal foods (infant food) | | | | | | | | | | | | | | | |
| 200 | Dry, precooked | 5 7 | 364 | 14 2 | 2 4 | 73 4 | 1 4 | 4 3 | 651 | 686 | 33 9 | (0) | 1 19 | 0 46 | 4 9† | (0) |
| | See also *Oatmeal* (infant food) | | | | | | | | | | | | | | | |
| | Chard, leaves and stalks | | | | | | | | | | | | | | | |
| 201 | Raw | 91 8 | 21 | 1 4 | 0 2 | 4 4 | 0 9 | 2 2 | 105‡ | 36 | 2 5 | 2800 | 0 06 | 0 07 | 0 4 | 38 |
| 202 | Cooked | 91 8 | 21 | 1 4 | 0 2 | 4 4 | 0 9 | 2 2 | 105‡ | 36 | 2 5 | 3110 | 0 04 | 0 06 | 0 4 | 17 |
| | Chard leaves only | | | | | | | | | | | | | | | |
| 203 | Raw | 91 0 | 27 | 2 6 | 0 4 | 4 8 | 0 8 | 1 2 | 105‡ | 36 | 2 5 | 8720 | 0 06 | 0 18 | 0 4 | 38 |
| 204 | Cooked | 91 0 | 27 | 2 6 | 0 4 | 4 8 | 0 8 | 1 2 | 105‡ | 36 | 2 5 | 9690 | 0 04 | 0 16 | 0 3 | 17 |
| | Cheese | | | | | | | | | | | | | | | |
| 205 | Blue mold domestic type | 40 0 | 368 | 21 5 | 30 5 | 2 0 | 0 | 6 0 | 315 | 339 | (0 5) | (1240) | 0 03 | 0 61 | 0 4 | (0) |
| 206 | Camembert | 52 2 | 299 | 17 5 | 24 7 | 1 8 | 0 | 3 8 | 105 | 184 | 0 5 | (1020) | 0 04 | 0 75 | 1 1 | (0) |
| 207 | Cheddar | 37 0 | 398 | 25 0 | 32 2 | 2 1 | 0 | 3 7 | 725 | 495 | 1 0 | 1400 | 0 02 | 0 42 | Trace | (0) |
| 208 | Cheddar processed | 40 0 | 370 | 23 2 | 30 0 | 1 9 | 0 | 4 9 | 673 | 787§ | 0 9 | (1300) | 0 02 | 0 41 | Trace | (0) |
| 209 | Cheese foods cheddar | 43 0 | 326 | 20 5 | 24 0 | 7 0 | 0 | 5 5 | 570 | 798 | 0 7 | (1070) | (0 02) | 0 58 | 0 2 | (0) |
| 210 | Cottage from skim milk | 76 5 | 95 | 19 5 | 0 5 | 2 0 | 0 | 1 5 | 96 | 189 | 0 3 | (20) | 0 02 | 0 31 | (0 1) | (0) |
| 211 | Cream cheese | 51 0 | 371 | 9 0 | 37 0 | 2 0 | 0 | 1 0 | 68 | 97 | 0 2 | (1450) | (0 01) | 0 22 | 0 1 | (0) |
| 212 | Limburger | 45 0 | 345 | 21 2 | 28 0 | 2 2 | 0 | 3 6 | 590 | 393 | 0 6 | 1280 | 0 08 | 0 50 | 0 2 | (0) |
| 213 | Parmesan | 30 0 | 393 | 36 0 | 26 0 | 2 9 | 0 | 5 1 | 1160 | 823 | 0 4 | (1060) | 0 02 | 0 73 | 0 2 | (0) |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 214 | *Swiss* | 39 0 | 370 | 27 5 | 28 0 | 1 7 | 0 | 3 8 | 925 | 563 | 0 9 | 1450 | 0 01 | (0 40) | (0 1) | (0) |
| 215 | *Swiss, processed* | 40 0 | 355 | 26 4 | 26 9 | 1 6 | 0 | 5 1 | 887 | 867/ | 0 9 | 1390 | 0 01 | 0 40 | 0 1 | (0) |
| 216 | Cherries sour sweet, and hybrid raw | 83 0 | 61 | 1 1 | 0 5 | 14 8 | 0 3 | 0 6 | 18 | 20 | 0 4 | 620 | 0 05 | 0 06 | 0 4 | 8 |
| 217 | Cherries, red, sour, pitted, canned | 86 6 | 48 | 0 8 | 0 3 | 11 9 | 0 1 | 0 4 | 11 | 12 | (0 3) | 720 | 0 03 | 0 02 | 0 2 | 6 |
| | Chicken ■ | | | | | | | | | | | | | | | |
| | Raw | | | | | | | | | | | | | | | |
| 218 | Broilers, total edible | 71 2 | 151 | 20 2 | 7 2 | 0 | 0 | 1 1 | 14 | 200 | 1 5 | (0) | 0 08 | 0 16 | 10 2 | (0) |
| 219 | Roasters total edible | 66 0 | 200 | 20 2 | 12 6 | 0 | 0 | 1 0 | 14 | 200 | 1 5 | (0) | 0 08 | 0 16 | 8 0 | (0) |
| 220 | Hens, total edible | 55 9 | 302 | 18 0 | 25 0 | 0 | 0 | 1 1 | 14 | 200 | 1 5 | (0) | 0 08 | 0 16 | 8 0 | (0) |
| | Fryers (cut up pieces) | | | | | | | | | | | | | | | |
| 221 | Breast | 74 9 | 104 | 23 3 | 0 5 | 0 | 0 | 1 2 | 14 | 212 | 1 1 | (0) | 0 07 | 0 09 | 10 5 | (0) |
| 222 | Leg | 74 5 | 112 | 20 5 | 2 7 | 0 | 0 | 1 1 | 15 | 188 | 1 8 | (0) | 0 10 | 0 24 | 5 6 | (0) |
| 223 | Canned, boned, meat only | 61 9 | 199 | 29 8 | 8 0 | 0 | 0 | 2 4 | 14 | 148 | 1 8 | (0) | 0 04 | 0 16 | 6 4 | (0) |
| | Chicken broth See *Soups, canned, bouillon, broth and consomme* | | | | | | | | | | | | | | | |
| | Chicken soup See *Soups, canned chicken* | | | | | | | | | | | | | | | |
| 224 | Chickpeas or garbanzos, dry, whole seed, raw | 10 6 | 359 | 20 8 | 4 7 | 60 9 | 5 3 | 3 0 | 92 | 375 | 7 1 | Trace | 0 55 | 0 17 | 1 5 | (2) |
| 225 | Chile con carne (without beans), canned▲ | 66 9 | 200 | 10 3 | 14 8 | 5 8 | 0 2 | 2 2 | 38 | 152 | 1 4 | 150 | 0 02 | 0 12 | 2 2 | |
| 226 | Chili sauce | 68 7 | 98 | 2 8 | 0 4 | 23 7 | 0 7 | 4 4 | (12) | (18) | (0 8) | (1880) | (0 09) | (0 07) | (2 2) | (11) |
| | Chocolate | | | | | | | | | | | | | | | |
| 227 | Bitter or unsweetened | 2 3 | 504 | (5 5) | 52 9 | 29 2□ | 2 6 | 3 2 | 98‡ | 446 | (4 4) | 60 | 0 05 | 0 24 | 1 1 | (0) |
| | Sweetened | | | | | | | | | | | | | | | |
| 228 | Plain | 1 4 | 472 | (2 0) | 29 8 | 62 7 | 1 4 | 1 4 | (63)‡ | (287) | 2 8 | (30) | (0 03) | (0 15) | (0 6) | (0) |
| | Milk See *Candy* | | | | | | | | | | | | | | | |
| | Milk, with almonds See *Candy* | | | | | | | | | | | | | | | |
| 229 | *Chocolate beverage, made with milk | 80 5 | 96 | 3 3 | 5 0 | 10 5 | 0 1 | 0 7 | 104 | 92 | 0 2 | 140 | 0 03 | 0 16 | 0 1 | 1 |
| 230 | Chocolate sirup | 39 0 | 209 | (1 2) | 1 1 | 56 6 | 0 6 | 0 6 | (15)‡ | (86) | (1 4) | | | | | |
| | Cider See *Apple juice* | | | | | | | | | | | | | | | |
| | Citron See *Candy* | | | | | | | | | | | | | | | |
| | Clams, long and round | | | | | | | | | | | | | | | |
| 231 | Raw, meat only | 80 3 | 81 | 12 8 | 1 4 | 3 4 | | 2 1 | (96) | (139) | (7 0) | 110 | 0 10 | 0 18 | (1 6) | |
| 232 | Canned, solids and liquid | 86 7 | 51 | 7 9 | 1 0 | 2 1 | | 2 3 | 87 | 125 | 6 3 | (80) | (0 05) | 0 10 | 1 1 | |
| 233 | Cocoa, breakfast, plain, dry powder | 3 9 | 298 | (8 0) | 23 8 | 48 9□ | 4 6 | 5 0 | 125‡ | 712 | 11 6 | (30) | 0 12 | 0 38 | 2 3 | (0) |
| 234 | *Cocoa beverage made with all milk | 79 0 | 95 | 3 8 | 4 6 | 10 9 | 0 1 | 0 9 | 119 | 114 | 0 4 | 160 | 0 04 | 0 19 | 0 2 | 1 |

* Indicates values calculated from a recipe, parentheses indicate imputed value
† Based on products ranging from 2 5 to 6 6 mg per 100 gm of cereal The niacin value of some products is as high as 23 0 mg
‡ *Calcium may not be available because of presence of oxalic acid*
§ 460 mg if the added emulsifying agent does not contain phosphorus
/ 540 mg if the added emulsifying agent does not contain phosphorus
■ Vitamin values are based on muscle meat only
▲ *Not less than 60 per cent meat, not more than 8 per cent cereals seasonings.*
□ Approximately one third of this total amount of carbohydrate calculated by difference is starch and sugar The remaining portion is made up of materials thought to be utilized only poorly if at all by the body

Table 144 Composition of Foods, 100 Grams, Edible Portion (Continued)

| | Food and Description | Water (%) | Food Energy (Cal) | Protein (Gm) | Fat (Gm) | Carbohydrate (Gm) Total | Carbohydrate (Gm) Fiber | Ash (Gm) | Calcium (Mg) | Phosphorus (Mg) | Iron (Mg) | Vitamin A Value (I U) | Thiamine (Mg) | Riboflavin (Mg) | Niacin (Mg) | Ascorbic Acid (Mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coconut | | | | | | | | | | | | | | | |
| 235 | Fresh, meat | 46.9 | 359 | 3.4 | 34.7 | 14.0 | 3.2 | 1.0 | 21 | 98 | 2.0 | 0 | 0.10 | 0.01 | 0.2 | 2 |
| 236 | Dried, shredded (sweetened) | 3.3 | 556 | 3.6 | 39.1 | 53.2 | 4.1 | 0.8 | 43 | 191 | 3.6 | 0 | Trace | Trace | Trace | (0) |
| 237 | Milk only | 93.6 | 25 | 0.3 | 0.4 | 5.0 | | 0.7 | 24 | 29 | 0.1 | 0 | Trace | Trace | 0.1 | 2 |
| | Cod | | | | | | | | | | | | | | | |
| 238 | Raw | 82.6 | 74 | 16.5 | 0.4 | 0 | 0 | 1.2 | 10 | 194 | 0.4 | 0 | 0.06 | 0.09 | 2.2 | 2 |
| 239 | Dried | 12.3 | 375 | 81.8 | 2.8 | 0 | 0 | 7.0 | (50) | 891 | 3.6 | 0 | 0.08 | 0.45 | 10.9 | (0) |
| 240 | *Coleslaw | 83.6 | 86 | 1.3 | 6.1 | 7.7 | 0.9 | 1.3 | 39 | 27 | 0.4 | 70 | 0.05 | 0.04 | 0.2 | 41 |
| | Collards | | | | | | | | | | | | | | | |
| 241 | Raw | 86.6 | 40 | 3.9 | 0.6 | 7.2 | 1.2 | 1.7 | 249 | 58 | 1.6 | 6870 | 0.11 | 0.27 | (2.0) | 100 |
| 242 | Cooked (boiled in small or moderate amount of water until tender) | 86.6 | 40 | 3.9 | 0.6 | 7.2 | 1.2 | 1.7 | 249 | 58 | 1.6 | 7630 | 0.08 | 0.24 | (1.7) | 44 |
| 243 | Cooked (boiled in large amount of water, long time) | 86.6 | 40 | 3.9 | 0.6 | 7.2 | 1.2 | 1.7 | 249 | 58 | 1.6 | 7630 | 0.07 | 0.21 | (1.4) | 33 |
| | Condensed milk. See *Milk, cow* | | | | | | | | | | | | | | | |
| 244 | Cookies, plain and assorted | 4.8 | 436 | 6.0 | 12.7 | 75.0 | | 1.6 | 22 | 65 | 0.6 | (0) | 0.04 | 0.04 | 0.5 | (0) |
| | Cooking oil See *Oils, salad or cooking* | | | | | | | | | | | | | | | |
| | Corn, sweet, white or yellow | | | | | | | | | | | | | | | |
| 245 | Raw | 73.9 | 92 | 3.7 | 1.2 | 20.5 | 0.8 | 0.7 | 9 | 120 | 0.5 | 390§ | 0.15 | 0.12 | 1.7 | 12 |
| 246 | Cooked | 75.5 | 85 | 2.7 | 0.7 | 20.2 | | 0.9 | 5 | 52 | 0.6 | 390§ | 0.11 | 0.10 | 1.4 | 8 |
| | Canned | | | | | | | | | | | | | | | |
| 247 | Solids and liquid | 80.5 | 67 | 2.0 | 0.5 | 16.1 | 0.8 | 0.9 | 4 | 51 | 0.5 | 200§ | 0.03 | 0.05 | 0.9 | 5 |
| 248 | Drained solids | 75.5 | 85 | 2.7 | 0.7 | 20.2 | 1.1 | 0.9 | 5 | 52 | 0.6 | 230§ | 0.03 | 0.06 | 0.9 | 5 |
| 249 | Frozen | 78.0 | 77 | 3.2 | 0.9 | 17.3 | 0.7 | 0.6 | 8 | 101 | 0.4 | 110 | 0.12 | 0.10 | 1.4 | 8 |
| | Corn and soy grits See *Breakfast foods, mixed cereals* | | | | | | | | | | | | | | | |
| | *Corn bread or muffins, made with | | | | | | | | | | | | | | | |
| 250 | Whole ground corn meal | 49.2 | 215 | 7.2 | 5.7 | 34.8 | 0.6 | 3.1 | 141 | 216 | 1.7 | 130/ | 0.15 | 0.18 | 0.8 | (0) |
| 251 | Enriched, degermed corn meal | 49.2 | 219 | 6.7 | 4.7 | 36.6 | 0.2 | 2.8 | 139 | 155 | 1.9 | 130* | 0.17 | 0.23 | 1.3 | (0) |
| 252 | Corn flakes | 3.6 | 385 | 8.1 | 0.4 | 85.0 | 0.6 | 2.9 | 11 | 58 | 1.3 | (0) | 0.04 | 0.10 | 1.6 | (0) |
| 253 | Corn flakes (added thiamine, niacin, and iron) | 3.6 | 385 | 8.1 | 0.4 | 85.0 | 0.6 | 2.9 | 11 | 58 | 2.2 | (0) | 0.41 | 0.10 | 2.2 | (0) |
| 254 | Corn flour | 12.0 | 368 | 7.8 | 2.6 | 76.8 | 0.7 | 0.8 | *6* | (*178*) | 1.8 | 340** | 0.20 | 0.06 | (1.4) | (0) |
| | Corn grits degermed | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Unenriched* | | | | | | | | | | | | | | | |
| 255 | Dry | 12.0 | 362 | 8.7 | 0.8 | 78.1 | 0.4 | 0.4 | 4 | 73 | 1.0 | 300†† | 0.13 | 0.04 | 1.2 | (0) |
| 256 | *Cooked | 87.1 | 51 | 1.2 | 0.1 | 11.0 | 0.1 | 0.6 | 1 | 10 | 0.1 | 40†† | 0.02 | 0.01 | 0.2 | (0) |
| | Enriched | | | | | | | | | | | | | | | |
| 257 | Dry | 12.0 | 362 | 8.7 | 0.8 | 78.1 | 0.4 | 0.4 | 4 | 73 | 2.9§ | 300†† | 0.44□ | 0.26□ | 3.5□ | (0) |
| 258 | *Cooked | 87.1 | 51 | 1.2 | 0.1 | 11.0 | 0.1 | 0.6 | 1 | 10 | 0.3 | 40†† | 0.04 | 0.03 | 0.4 | (0) |
| | Corn meal, white or yellow | | | | | | | | | | | | | | | |
| | Whole ground dry | | | | | | | | | | | | | | | |
| 259 | Unbolted | 12.0 | 355 | 9.2 | 3.9 | 73.7 | 1.6 | 1.2 | 10 | 256 | 2.4 | 510‡‡ | 0.38 | 0.11 | 2.0 | (0) |
| 260 | Bolted | 12.0 | 362 | 9.0 | 3.4 | 74.5 | 1.0 | 1.1 | 6 | (178) | 1.8 | 440‡‡ | 0.30 | 0.08 | 1.9 | (0) |
| | Degermed, unenriched | | | | | | | | | | | | | | | |
| 261 | Dry | 12.0 | 363 | 7.9 | 1.2 | 78.4 | 0.6 | 0.5 | 6 | 99 | 1.1 | 300‡‡ | 0.14 | 0.05 | 1.0 | (0) |
| 262 | *Cooked | 87.7 | 50 | 1.1 | 0.2 | 10.7 | 0.1 | 0.3 | 1 | 14 | 0.2 | 40‡‡ | 0.02 | 0.01 | 0.1 | (0) |
| | Degermed, enriched | | | | | | | | | | | | | | | |
| 263 | Dry | 12.0 | 363 | 7.9 | 1.2 | 78.4 | 0.6 | 0.5 | 6 | 99 | 2.9□ | 300‡‡ | 0.44§ | 0.26□ | 3.5□ | (0) |
| 264 | *Cooked | 87.7 | 50 | 1.1 | 0.2 | 10.7 | 0.1 | 0.3 | 1 | 14 | 0.4 | 40‡‡ | 0.06 | 0.04 | 0.5 | (0) |
| | Self rising, dry | | | | | | | | | | | | | | | |
| 265 | Unenriched | 12.0 | 340 | 8.7 | 3.7 | 70.8 | 1.5 | 4.8 | 262 | 634 | 2.3 | 480‡‡ | 0.36 | 0.10 | 1.9 | (0) |
| 266 | Enriched | 12.0 | 340 | 8.7 | 3.7 | 70.8 | 1.5 | 4.8 | 262 | 634 | 2.9□ | 480‡‡ | 0.44§ | 0.26□ | 3.5□ | (0) |
| | Corn oil. See *Oils, salad or cooking* | | | | | | | | | | | | | | | |
| | Corn sirup See *Sirup, table blends* | | | | | | | | | | | | | | | |
| | *Cornstarch* See *Starch* | | | | | | | | | | | | | | | |
| | Cornstarch pudding See *Blanc mange* | | | | | | | | | | | | | | | |
| | Corn sugar See *Sugars* | | | | | | | | | | | | | | | |
| | Cottonseed oil See *Oils, salad or cooking* | | | | | | | | | | | | | | | |
| | Cowpeas | | | | | | | | | | | | | | | |
| | Immature seeds | | | | | | | | | | | | | | | |
| 267 | Raw | 65.9 | 130 | 9.4 | 0.6 | 22.7 | | 1.4 | 37 | 182 | 2.5 | 360 | 0.39 | 0.09 | 0.9 | 31 |
| 268 | Cooked | 74.9 | 94 | 7.1 | 0.6 | 15.9 | | 1.5 | 37 | 182 | 2.5 | 390 | 0.29 | 0.08 | 0.8 | 20 |
| 269 | Mature seeds dry | 10.6 | 342 | 22.9 | 1.4 | 61.6 | 4.2 | 3.5 | 77 | 451 | 6.5 | 30 | 0.92 | 0.16 | 2.2 | 2 |
| 270 | Young green pods raw (including asparagus beans) | 86.2 | 44 | 3.4 | 0.3 | 9.2 | 1.8 | 0.9 | 53 | 65 | 1.1 | 1670 | 0.16 | 0.10 | 1.1 | 34 |

* Indicates values calculated from a recipe parentheses indicate imputed value

† Approximately one third of this total amount of carbohydrate calculated by difference is starch and sugar The remaining portion is made up of materials thought to be utilized only poorly if at all by the body

‡ Calcium may not be available because of presence of oxalic acid

§ Vitamin A based on yellow corn white corn contains only a trace

/ Based on recipe using white corn meal if yellow corn meal is used, the vitamin A value is 330 I U

■ Based on recipe using white corn meal if yellow corn meal is used the vitamin A value is 250 I U

** Vitamin A based on yellow corn flour white corn flour contains only a trace

†† Vitamin A based on yellow corn grits white corn grits contain only a trace

□ Iron, thiamine, riboflavin, and niacin are based on the minimum level of enrichment specified in standards of identity promulgated under the Food, Drug and Cosmetic Act

‡‡ Vitamin A based on yellow corn meal white corn meal contains only a trace

**Table 144 Composition of Foods, 100 Grams, Edible Portion (Continued)**

| | Food and Description | Water (%) | Food Energy (Cal.) | Protein (Gm.) | Fat (Gm.) | Carbohydrate (Gm.) | | Ash (Gm.) | Calcium (Mg.) | Phosphorus (Mg.) | Iron (Mg.) | Vitamin A Value (I.U.) | Thiamine (Mg.) | Riboflavin (Mg.) | Niacin (Mg.) | Ascorbic Acid (Mg.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Total | Fiber | | | | | | | | | |
| | Crabs, Atlantic and Pacific, hard shell | | | | | | | | | | | | | | | |
| 271 | Raw | 80.0 | 86 | 16.1 | 1.6 | 0.6 | | 1.7 | (39) | (160) | (0.8) | | 0.14 | 0.06 | 2.7 | |
| 272 | Canned or cooked, *meat only* | 77.2 | 104 | 16.9 | 2.9 | 1.3 | | 1.7 | 45 | 182 | 0.9 | | (0.05) | (0.06) | (2.5) | |
| | Crackers | | | | | | | | | | | | | | | |
| 273 | Graham | 5.5 | 393 | 8.0 | 10.0 | 74.3 | 0.8 | 2.2 | 20 | 203 | 1.9 | (0) | 0.30 | 0.12 | 1.5 | (0) |
| 274 | Saltines | 4.6 | 431 | 9.2 | 11.8 | 71.1 | 0.4 | 3.3 | 19 | 92 | 1.0 | (0) | 0.06 | 0.04 | 1.0 | (0) |
| 275 | Soda, plain | 5.7 | 420 | 9.6 | 9.6 | 72.7 | 0.2 | 2.4 | 20 | 96 | 1.1 | (0) | 0.06 | 0.05 | 1.1 | (0) |
| | Cracker meal. See *Crackers, soda* | | | | | | | | | | | | | | | |
| | Cranberries | | | | | | | | | | | | | | | |
| 276 | Raw | 87.4 | 48 | 0.4 | 0.7 | 11.3 | 1.4 | 0.2 | 14 | 11 | 0.6 | 40 | (0.03) | (0.02) | 0.1 | 12 |
| 277 | Dried | 4.9 | 368 | 2.8 | 6.6 | 84.3 | 8.7 | 1.4 | 82 | 22 | 3.4 | (300) | 0.19 | 0.18 | 0.9 | 34 |
| 278 | Cranberry sauce, sweetened, canned or cooked | 48.1 | 198 | 0.1 | 0.3 | 51.4 | 0.4 | 0.1 | (8) | (7) | (0.3) | (30) | (0.02) | (0.02) | (0.1) | 2 |
| | Cream | | | | | | | | | | | | | | | |
| 279 | Light, table or coffee | 72.5 | 204 | 2.9 | 20.0 | 4.0 | 0 | 0.6 | 97 | 77 | 0.1 | 830 | 0.03 | 0.14 | 0.1 | 1 |
| 280 | Heavy or whipping | 59.0 | 330 | 2.3 | 35.0 | 3.2 | 0 | 0.5 | 78 | 61 | 0.0 | 1440 | 0.02 | 0.11 | 0.1 | 1 |
| | Cress, garden | | | | | | | | | | | | | | | |
| 281 | Raw | 87.2 | 41 | 4.2 | 1.4 | 5.3 | 1.2 | 1.9 | 211 | (38) | (2.9) | 2970 | 0.11 | 0.17 | 1.0 | 87 |
| 282 | Cooked (boiled in small or moderate amount of water until tender) | 87.2 | 41 | 4.2 | 1.4 | 5.3 | 1.2 | 1.9 | 211 | (38) | (2.9) | 3300 | 0.07 | 0.15 | 0.8 | 39 |
| 283 | Cooked (boiled in large amount of water a long time) | 87.2 | 41 | 4.2 | 1.4 | 5.3 | 1.2 | 1.9 | 211 | (38) | (2.9) | 3300 | 0.06 | 0.13 | 0.7 | 29 |
| 284 | Cress water, leaves and stems, raw | 93.6 | 18 | 1.7 | 0.3 | 3.3 | 0.5 | 1.1 | 195 | 46 | 2.0 | 4720 | 0.08 | 0.16 | 0.8 | 77 |
| 285 | Croaker, raw | 77.4 | 96 | 17.8 | 2.2 | 0 | 0 | 1.3 | | | | | 0.16 | 0.06 | (1.8) | |
| 286 | Cucumbers, raw | 96.1 | 12 | 0.7 | 0.1 | 2.7 | 0.5 | 0.4 | 10 | 21 | 0.3† | 0† | 0.03 | 0.04 | 0.2 | 8 |
| | Cucumber pickles. See *Pickles* | | | | | | | | | | | | | | | |
| 287 | Currants, red, raw | 84.4 | 55 | 1.2 | 0.2 | 13.6 | 4.0 | 0.6 | 36 | 33 | 0.9 | 120 | 0.04 | | | 36 |
| 288 | *Custard, baked | 77.3 | 114 | 5.3 | 5.4 | 11.2 | 0 | 0.8 | 114 | 119 | 0.5 | 340 | 0.05 | 0.20 | 0.1 | Trace |
| | Custard pie. See *Pies* | | | | | | | | | | | | | | | |
| 289 | Custard pudding, canned, strained (infant food) | 75.2 | 108 | 3.0 | 2.7 | 18.3 | 0.1 | 0.8 | 92 | 82 | 0.3 | 220 | 0.02 | 0.12 | 0.1 | 1 |
| | Dandelion greens | | | | | | | | | | | | | | | |
| 290 | Raw | 85.8 | 44 | 2.7 | 0.7 | 8.8 | 1.8 | 2.0 | 187 | 70 | 3.1 | 13650 | 0.19 | 0.14 | (0.8) | 36 |
| 291 | Cooked | 85.8 | 44 | 2.7 | 0.7 | 8.8 | 1.8 | 2.0 | 187 | 70 | 3.1 | 15170 | 0.13 | 0.12 | (0.7) | 16 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 292 | Dates fresh" and dried | 20 0 | 284 | 2 2 | 0 6 | 75 4 | 2 4 | 1 8 | 72 | 60 | 2 1 | 60 | 0 09 | 0 10 | 2 2 | (0) |
| 293 | Doughnuts cake type | 18 7 | 425 | 6 6 | 21 0 | 52 7 | 0 2 | 1 0 | 73 | 286 | (0 7) | *140* | *0 16* | *0 13* | 1 2 | (0) |
| 294 | Eels raw | 71 6 | 162 | 18 6 | 9 1 | 0 | 0 | 1 0 | 18 | 202 | 0 7 | 1800 | 0 28 | 0 37 | 1 4 | |
| 295 | Eggplant, raw | 92 7 | 24 | 1 1 | 0 2 | 5 5 | 0 9 | 0 5 | 15 | 37 | 0 4 | 30 | 0 04 | 0 05 | 0 6 | 5 |
| | Eggs hen, fresh, stored, or frozen | | | | | | | | | | | | | | | |
| | Raw | | | | | | | | | | | | | | | |
| 296 | Whole | 74 0 | 162 | 12 8 | 11 5 | 0 7 | 0 | 1 0 | 54 | 210 | 2 7 | 1140 | 0 10 | 0 29 | 0 1 | 0 |
| 297 | White | 87 8 | 50 | 10 8 | 0 | 0 8 | 0 | 0 6 | 6 | 17 | 0 2 | (0) | 0 | 0 26 | (0 1) | 0 |
| 298 | Yolk | 49 4 | 361 | 16 3 | 31 9 | 0 7 | 0 | 1 7 | 147 | 586 | 7 2 | 3210 | 0 27 | 0 35 | Trace | 0 |
| | Cooked | | | | | | | | | | | | | | | |
| 299 | Hard-cooked | 74 0 | *162* | *12 8* | *11 5* | *0 7* | *0* | 1 0 | 54 | 210 | 2 7 | 1140 | 0 08 | 0 27 | 0 1 | 0 |
| 300 | *Omelet | 72 5 | 171 | 11 0 | 12 8 | 2 2 | 0 | 1 5 | 81 | 194 | 2 1 | 1040 | 0 08 | 0 27 | 0 1 | 0 |
| 301 | Poached | 73 7 | 160 | 12 7 | 11 4 | 0 6 | 0 | 1 5 | 54 | 210 | 2 7 | 1130 | 0 08 | 0 24 | 0 1 | 0 |
| 302 | *Scrambled | 72 5 | 171 | 11 0 | 12 8 | 2 2 | 0 | 1 5 | 81 | 194 | 2 1 | 1040 | 0 08 | 0 27 | 0 1 | 0 |
| | Dried | | | | | | | | | | | | | | | |
| 303 | Whole | 5 0 | 592 | 46 8 | 42 0 | 2 5 | 0 | 3 6 | 190 | 767 | 8 8 | 3740 | 0 34 | 1 06 | 0 2 | 0 |
| 304 | White | 3 0 | 398 | 85 9 | 0 0 | 6 3 | 0 | 4 8 | 48 | 135 | 1 6 | 0 | 0 | 2 05 | 0 7 | 0 |
| 305 | Yolk | 3 0 | 693 | 31 2 | 61 2 | 1 3 | 0 | 3 3 | 282 | 1123 | 13 8 | 5540 | 0 50 | 0 66 | 0 1 | 0 |
| 306 | Endive raw | 93 3 | 20 | 1 6 | 0 2 | 4 0 | 0 8 | 0 9 | 79 | 56 | 1 7 | 3000 | 0 07 | 0 12 | 0 4 | 11 |
| | Escarole raw See *Endive* | | | | | | | | | | | | | | | |
| | Evaporated milk. See *Milk cow* | | | | | | | | | | | | | | | |
| | Farina | | | | | | | | | | | | | | | |
| | Unenriched | | | | | | | | | | | | | | | |
| 307 | Raw | 10 5 | 370 | 10 9 | 0 8 | 77 4 | 0 4 | 0 4 | 28 | 112 | 1 0 | (0) | 0 06 | 0 06 | 0 8 | (0) |
| 308 | *Cooked | 89 2 | 44 | 1 3 | 0 1 | 9 1 | 0 0 | 0 3 | 3 | 13 | *0 1* | *0* | *0 01* | *0 01* | *0 1* | *(0)* |
| | Enriched | | | | | | | | | | | | | | | |
| 309 | Raw | 10 5 | 370 | 10 9 | 0 8 | 77 4 | 0 4 | 0 4 | 28 | 112 | 1 3‡ | (0) | 0 37‡ | 0 26‡ | 1 3‡ | (0) |
| 310 | *Cooked | 89 2 | 44 | 1 3 | 0 1 | 9 1 | 0 0 | 0 3 | 3 | 13 | 0 2 | 0 | 0 04 | 0 03 | 0 2 | (0) |
| 311 | Fats, cooking (vegetable fat) | 0 0 | 884 | 0 0 | 100 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Figs | | | | | | | | | | | | | | | |
| 312 | Raw | 78 0 | 79 | 1 4 | 0 4 | 19 6 | 1 7 | 0 6 | 54 | 32 | 0 6 | 80 | 0 06 | 0 05 | 0 5 | 2 |
| 313 | Canned, sirup pack, solids and liquid | 68 5 | 113 | 0 8 | 0 3 | 30 0 | 0 9 | 0 4 | 35 | 21 | 0 4 | 50 | 0 03 | 0 03 | 0 4 | Trace |
| 314 | Dried | 24 0 | 270 | 4 0 | 1 2 | 68 4 | 5 8 | 2 4 | 186 | 111 | 3 0 | 80 | 0 16 | 0 12 | 1 7 | (0) |
| 315 | Fig bars | 13 8 | 350 | 4 2 | 4 8 | 75 8 | *1 7* | *1 4* | 69 | 69 | 1 3 | *0* | *0 02* | *0 06* | 0 9 | (0) |
| | Fish. See individual kind, as *Bluefish*, *Cod*, *Halibut*, etc | | | | | | | | | | | | | | | |
| 316 | Flounder, summer and winter, raw | 82 7 | 68 | 14 9 | 0 5 | 0 | 0 | 1 3 | 61 | 195 | 0 8 | | 0 06 | 0 05 | 1 7 | |

* Indicates values calculated from a recipe, parentheses indicate imputed value.

† Based on pared cucumbers, unpared contain about 1 2 mg of iron and 260 I U of vitamin A per 100 gm.

‡ Iron, thiamine, riboflavin, and niacin are based on the minimum levels of enrichment specified in standards of identity promulgated under the Food, Drug, and Cosmetic Act.

Table 144 Composition of Foods, 100 Grams, Edible Portion (Continued)

| | Food and Description | Water (%) | Food Energy (Cal) | Protein (Gm) | Fat (Gm) | Carbohydrate (Gm) Total | Carbohydrate (Gm) Fiber | Ash (Gm) | Calcium (Mg) | Phosphorus (Mg) | Iron (Mg) | Vitamin A Value (I U) | Thiamine (Mg) | Riboflavin (Mg) | Niacin (Mg) | Ascorbic Acid (Mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Flour See *Corn, Rye, Wheat flours*, etc | | | | | | | | | | | | | | | |
| | Frankfurters See *Sausage* | | | | | | | | | | | | | | | |
| 317 | Frog legs raw | 81.9 | 73 | 16.4 | 0.3 | 0 | 0 | 1.1 | 18 | 147 | 1.1 | 0 | 0.14 | 0.25 | 1.2 | |
| 318 | Fruit cocktail, canned, solids and liquid | 80.6 | 70 | 0.4 | 0.2 | 18.6 | 0.4 | 0.3 | 9 | 12 | 0.4 | 160 | 0.01 | 0.01 | 0.4 | 2 |
| | Garbanzos See *Chickpeas* | | | | | | | | | | | | | | | |
| | Gelatin, dry | | | | | | | | | | | | | | | |
| 319 | Plain | 13.0 | 335 | 85.6 | 0.1 | 0 | 0 | 1.3 | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) |
| 320 | Dessert powder | 1.6 | 380 | 9.4 | 0.0 | 88.7 | 0 | 0.3 | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) |
| | *Gelatin dessert, ready to-serve | | | | | | | | | | | | | | | |
| 321 | Plain | 83.1 | 65 | 1.6 | 0.0 | 15.2 | 0 | 0.1 | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) |
| 322 | With fruit added | 80.7 | 71 | 1.4 | 0.1 | 17.5 | 0.2 | 0.3 | 6 | 11 | 0.3 | 110 | 0.03 | 0.02 | 0.2 | 3 |
| | Ginger ale See *Beverages, carbonated* | | | | | | | | | | | | | | | |
| 323 | *Gingerbread | 30.4 | 327 | 3.9 | 12.0 | 51.6 | 0.1 | 2.1 | 114 | 71 | 2.5 | 100 | 0.04 | 0.08 | 1.0 | (0) |
| | Goat milk See *Milk, goat* | | | | | | | | | | | | | | | |
| 324 | Gooseberries, raw | 88.9 | 39 | 0.8 | 0.2 | 9.7 | 1.9 | 0.4 | 22 | 28 | 0.5 | 290 | | | | 33 |
| | Grapefruit | | | | | | | | | | | | | | | |
| 325 | Raw | 88.8 | 40 | 0.5 | 0.2 | 10.1 | 0.3 | 0.4 | 22 | 18 | 0.2 | Trace | 0.04 | 0.02 | 0.2 | 40 |
| 326 | Canned in sirup, solids and liquid | 79.8 | 72 | 0.6 | 0.2 | 19.1 | 0.2 | 0.4 | 13 | 14 | 0.3 | Trace | 0.03 | 0.02 | 0.2 | 30 |
| | Grapefruit juice | | | | | | | | | | | | | | | |
| 327 | Fresh | 89.8 | 36 | 0.5 | 0.1 | 9.2 | 0.1 | 0.4 | 8 | 13 | 0.3 | Trace | 0.04 | 0.02 | 0.2 | 40 |
| | Canned | | | | | | | | | | | | | | | |
| 328 | Unsweetened | 89.2 | 38 | 0.5 | 0.1 | 9.8 | 0.1 | 0.4 | 8 | 13 | 0.3 | Trace | 0.03 | 0.02 | 0.2 | 35 |
| 329 | Sweetened | 85.3 | 52 | 0.5 | 0.1 | 13.7 | 0.1 | 0.4 | 8 | 13 | 0.3 | Trace | 0.03 | 0.02 | 0.2 | 35 |
| 330 | Grapefruit juice concentrate, *frozen* | 58.0 | 147 | 1.9 | 0.4 | 38.1 | 0.2 | 1.6 | 31 | 51 | 1.2 | 30 | 0.12 | 0.07 | 0.7 | 135 |
| | Grapefruit orange juice blend | | | | | | | | | | | | | | | |
| | Canned | | | | | | | | | | | | | | | |
| 331 | Unsweetened | 88.5 | 40 | 0.6 | 0.1 | 10.4 | 0.1 | 0.4 | 9 | 15 | 0.3 | 40 | 0.05 | 0.02 | 0.2 | 38 |
| 332 | Sweetened | 85.1 | 52 | 0.5 | 0.1 | 13.9 | 0.1 | 0.4 | 9 | 15 | 0.3 | 40 | 0.05 | 0.02 | 0.2 | 38 |
| 333 | Frozen concentrate | 58.0 | 147 | 2.2 | 0.4 | 37.9 | 0.2 | 1.5 | 33 | 55 | 1.1 | 160 | 0.17 | 0.06 | 0.7 | 137 |
| | Grapes, raw | | | | | | | | | | | | | | | |
| 334 | American type (slip skin) as Concord, Delaware, Niagara, and Scuppernong | 81.9 | 70 | 1.4 | 1.4 | 14.9 | 0.5 | 0.4 | 17 | 21 | 0.6 | 80 | 0.06 | 0.04 | 0.2 | 4 |
| 335 | European type (adherent skin) as Malaga, Muscat, Sultanina (Thompson Seedless), and Flame Tokay | 81.6 | 66 | 0.8 | 0.4 | 16.7 | 0.5 | 0.5 | 17 | 21 | 0.6 | 80 | 0.06 | 0.04 | 0.2 | 4 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 336 | Grape juice, bottled commercial | 81.0 | 67 | 0.4 | 0.0 | 18.2 | | 0.4 | 10 | 10 | 0.3 | | 0.04 | 0.05 | (0.2) | Trace |
| | Griddlecakes See *Pancakes* | | | | | | | | | | | | | | | |
| 337 | Guavas common, raw | 80.6 | 70 | 1.0 | 0.6 | 17.1 | 5.5 | 0.7 | 30 | 29 | 0.7 | 250 | 0.07 | 0.04 | 1.2 | 302 |
| | Haddock | | | | | | | | | | | | | | | |
| 338 | Raw | 80.7 | 79 | 18.2 | 0.1 | 0 | 0 | 1.4 | 23 | 197 | 0.7 | | 0.05 | 0.08 | 2.4 | |
| 339 | Cooked, fried | 66.9 | 158 | 18.7 | 5.5 | 7.0 | | 1.9 | 18 | 182 | 0.6 | | 0.04 | 0.09 | 2.6 | |
| | Halibut | | | | | | | | | | | | | | | |
| 340 | Raw | 75.4 | 126 | 18.6 | 5.2 | 0 | 0 | 1.0 | 13 | 211 | 0.7 | 440 | 0.07 | 0.06 | 9.2 | |
| 341 | Cooked, broiled | 64.2 | 182 | 26.2 | 7.8 | 0 | 0 | 1.9 | 14 | 267 | 0.8 | | 0.06 | 0.07 | 10.5 | |
| | Ham See *Pork* | | | | | | | | | | | | | | | |
| | Hamburger See *Beef* | | | | | | | | | | | | | | | |
| | Heart | | | | | | | | | | | | | | | |
| 342 | Beef, lean, raw | 77.6 | 108 | 16.9 | 3.7 | 0.7 | 0 | 1.1 | 9 | 203 | 4.6 | 30 | 0.58 | 0.89 | 7.8 | 6 |
| 343 | Calf, canned, strained (infant food) | 82.7 | 81 | 13.4 | 2.5 | 0.2 | 0 | 1.2 | 12 | 150 | 3.6 | | 0.06 | 0.82 | 4.5 | |
| 344 | Chicken, raw | 69.6 | 157 | 20.5 | 7.0 | 1.6 | 0 | 1.3 | 23 | 142 | 1.7 | 30 | 0.12 | 0.91 | 5.2 | 6 |
| 345 | Pork, raw | 76.8 | 117 | 16.9 | 4.8 | 0.4 | 0 | 1.1 | 35 | 132 | 2.7 | 30 | 0.43 | 1.24 | 6.0 | 6 |
| 346 | Herring, Atlantic, raw | 67.2 | 191 | 18.3 | 12.5 | 0 | 0 | 2.7 | | 256 | 1.1 | 110 | 0.02 | 0.15 | 3.4 | |
| 347 | Herring, lake, raw | 74.0 | 140 | 18.5 | 6.8 | 0 | 0 | 1.1 | 12 | 152 | 0.5 | (100) | 0.09 | 0.09 | 3.1 | |
| 348 | Herring, Pacific raw | 79.6 | 94 | 16.6 | 2.6 | 0 | 0 | 1.3 | | | | 100 | 0.02 | 0.22 | (2.2) | |
| 349 | Herring, smoked, kippered | 61.0 | 211 | 22.2 | 12.9 | 0 | 0 | 4.0 | 66 | 254 | (1.4) | 0 | Trace | 0.28 | (2.9) | |
| | Hominy, dry See *Corn grits* | | | | | | | | | | | | | | | |
| 350 | *Honey*, *strained or extracted* | 20.0 | 294 | 0.3 | 0 | 79.5 | | 0.2 | 5 | 16 | 0.9 | (0) | Trace | 0.04 | 0.2 | 4 |
| 351 | Honeydew melon, raw | 90.5 | 32 | 0.5 | 0 | 8.5 | 0.4 | 0.5 | (17) | (16) | (0.4) | 40 | 0.05 | 0.03 | 0.2 | 23 |
| 352 | Ice cream, plain | 62.1 | 207 | 4.0 | 12.5 | 20.6 | 0 | 0.8 | 123 | 99 | 0.1 | 520 | 0.04 | 0.19 | 0.1 | 1 |
| 353 | Jams marmalades, preserves | 28.0 | 278 | 0.5 | 0.3 | 70.8 | 0.6 | 0.4 | 12 | 12 | 0.3 | 10 | 0.02 | 0.02 | 0.2 | 6 |
| 354 | Jellies | 34.5 | 252 | 0.2 | 0.0 | 65.0 | 0 | 0.3 | (12) | (12) | (0.3) | (10) | (0.02) | (0.02) | (0.2) | 4 |
| | Kale | | | | | | | | | | | | | | | |
| 355 | Raw | 86.6 | 40 | 3.9 | 0.6 | 7.2 | 1.2 | 1.7 | 225 | 62 | 2.2 | 7540 | 0.10 | 0.26 | 2.0 | 115 |
| 356 | Cooked | 86.6 | 40 | 3.9 | 0.6 | 7.2 | 1.2 | 1.7 | 225 | 62 | 2.2 | 8380 | 0.07 | 0.23 | 1.7 | 51 |
| 357 | Frozen | 86.6 | 40 | 3.9 | 0.6 | 7.2 | 1.2 | 1.7 | 225 | 62 | 2.2 | 7000 | 0.08 | 0.22 | 1.7 | 47 |
| | Kidneys, raw | | | | | | | | | | | | | | | |
| 358 | Beef | 74.9 | 141 | 15.0 | 8.1 | 0.9 | 0 | 1.1 | 9 | 221 | 7.9 | 1150 | 0.37 | 2.55 | 6.4 | 13 |
| 359 | Pork | 77.1 | 114 | 16.3 | 4.6 | 0.8 | 0 | 1.2 | 11 | 246 | 8.0 | 130 | 0.58 | 1.74 | 9.8 | 13 |
| 360 | Sheep | 77.8 | 105 | 16.6 | 3.3 | 1.0 | 0 | 1.3 | 13 | 237 | 9.2 | (1150) | 0.51 | 2.42 | 7.4 | 13 |
| | Kohlrabi | | | | | | | | | | | | | | | |
| 361 | Raw | 90.1 | 30 | 2.1 | 0.1 | 6.7 | 1.1 | 1.0 | 46 | 50 | 0.6 | Trace | 0.06 | 0.05 | 0.2 | 61 |
| 362 | Cooked | 90.1 | 30 | 2.1 | 0.1 | 6.7 | 1.1 | 1.0 | 46 | 50 | 0.6 | Trace | 0.04 | 0.04 | 0.2 | 37 |
| | *Lamb* | | | | | | | | | | | | | | | |
| | Carcass or side, raw | | | | | | | | | | | | | | | |
| 363 | Thin | 66.3 | 206 | 17.1 | 14.8 | 0 | 0 | 0.9 | 10 | 191 | 2.6 | (0) | 0.15 | 0.21 | 4.9 | 0 |
| 364 | Medium fat | 55.8 | 317 | 15.7 | 27.7 | 0 | 0 | 0.8 | 9 | 157 | 2.4 | (0) | 0.14 | 0.20 | 4.5 | 0 |
| 365 | Fat | 46.2 | 414 | 13.0 | 39.8 | 0 | 0 | 0.7 | 8 | 93 | 2.0 | (0) | 0.12 | 0.16 | 3.8 | 0 |

Indicates values calculated from a recipe parentheses indicate imputed value

Table 144 Composition of Foods, 100 Grams, Edible Portion (Continued)

| No. | Food and Description | Water (%) | Food Energy (Cal) | Protein (Gm) | Fat (Gm) | Carbohydrate (Gm) Total | Carbohydrate (Gm) Fiber | Ash (Gm) | Calcium (Mg) | Phosphorus (Mg) | Iron (Mg) | Vitamin A Value (I U) | Thiamine (Mg) | Riboflavin (Mg) | Niacin (Mg) | Ascorbic Acid (Mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lamb (Continued) | | | | | | | | | | | | | | | |
| | Retail items [a] medium fat | | | | | | | | | | | | | | | |
| | Rib chop | | | | | | | | | | | | | | | |
| 366 | Raw | 51.9 | 356 | 14.9 | 32.4 | 0 | 0 | 0.8 | 9 | 138 | 2.2 | (0) | 0.13 | 0.18 | 4.3 | 0 |
| 367 | Cooked | 40.0 | 418 | 24.0 | 35.0 | 0 | 0 | 1.2 | 11 | 200 | 3.0 | (0) | 0.14 | 0.26 | 5.6 | 0 |
| | Shoulder roast (wholesale 3 rib) | | | | | | | | | | | | | | | |
| 368 | Raw | 58.3 | 295 | 15.6 | 25.3 | 0 | 0 | 0.8 | 9 | 155 | 2.3 | (0) | 0.14 | 0.19 | 4.5 | 0 |
| 369 | Cooked | 50.0 | 342 | 21.0 | 28.0 | 0 | 0 | 1.0 | 9 | 188 | 2.6 | (0) | 0.12 | 0.22 | 4.6 | 0 |
| | Leg roast (wholesale leg) | | | | | | | | | | | | | | | |
| 370 | Raw | 63.7 | 235 | 18.0 | 17.5 | 0 | 0 | 0.9 | 10 | 213 | 2.7 | (0) | 0.16 | 0.22 | 5.2 | 0 |
| 371 | Cooked | 56.0 | 274 | 24.0 | 19.0 | 0 | 0 | 1.1 | 10 | 257 | 3.1 | (0) | 0.14 | 0.25 | 5.1 | 0 |
| 372 | Canned, strained (infant food) | 78.6 | 107 | 15.6 | 4.5 | 0 | 0 | 1.3 | 16 | 170 | 2.3 | (0) | 0.03 | 0.26 | 4.0 | 0 |
| | Lamb and vegetable soup canned, strained (infant food) See *Soups, canned, vegetable and lamb* | | | | | | | | | | | | | | | |
| 373 | Lard | 0.0 | 902 | 0.0 | 100.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 374 | Lemons | 89.3 | 32 | 0.9 | 0.6 | 8.7 | 0.9 | 0.5 | 40 | 22 | 0.6 | 0 | 0.04 | Trace | 0.1 | 50 |
| | Lemon juice | | | | | | | | | | | | | | | |
| 375 | Fresh | 91.4 | 24 | 0.4 | 0.2 | 7.7 | 0.0 | 0.3 | 14 | 11 | 0.1 | 0 | 0.04 | Trace | 0.1 | 50 |
| | Canned | | | | | | | | | | | | | | | |
| 376 | Unsweetened | 91.4 | 24 | 0.4 | 0.2 | 7.7 | 0.0 | 0.3 | 14 | 11 | 0.1 | 0 | 0.04 | Trace | 0.1 | 42 |
| 377 | Concentrate | 58.0 | 116 | 2.0 | 1.0 | 37.5 | 0.1 | 1.5 | 68 | 54 | 0.5 | (0) | 0.22 | 0.02 | 0.7 | 230 |
| | Lentils, dry | | | | | | | | | | | | | | | |
| 378 | Whole (entire seeds) | 11.2 | 337 | 25.0 | 1.0 | 59.5 | 3.7 | 3.3 | 59 | 423 | 7.4 | 570 | 0.56 | 0.24 | 2.2 | 5 |
| 379 | Split (without seed coat) | 12.2 | 339 | 24.0 | 1.2 | 60.4 | 1.7 | 2.2 | 34 | 292 | 7.4 | 570 | 0.56 | 0.24 | 2.2 | 5 |
| | Lettuce, raw | | | | | | | | | | | | | | | |
| 380 | Headed | 94.8 | 15 | 1.2 | 0.2 | 2.9 | 0.6 | 0.9 | 22 | 25 | 0.5 | 540 | 0.04 | 0.08 | 0.2 | 8 |
| 381 | All other | 94.8 | 15 | 1.2 | 0.2 | 2.9 | 0.6 | 0.9 | 62 | 20 | 1.1 | 1620 | 0.04 | 0.08 | 0.2 | 18 |
| 382 | Limes | 86.0 | 37 | 0.8 | 0.1 | 12.3 | (0.9) | 0.8 | (40) | (22) | (0.6) | 0 | (0.04) | (trace) | (0.1) | 27 |
| 383 | Lime juice, fresh | 91.0 | 24 | 0.4 | 0.0 | 8.3 | 0.0 | 0.3 | (14) | (11) | (0.1) | 0 | (0.04) | (trace) | (0.1) | 27 |
| | Liver | | | | | | | | | | | | | | | |
| | Beef | | | | | | | | | | | | | | | |
| 384 | Raw | 69.7 | 136 | 19.7 | 3.2 | 6.0 | 0 | 1.4 | 7 | 358 | 6.6 | 43900 | 0.26 | 3.33 | 13.7 | 31 |
| 385 | Cooked, fried | 57.2 | 208 | 23.6 | 7.7 | 9.7 | 0 | 1.8 | 8 | 486 | 7.8 | 53500 | 0.26 | 3.96 | 14.8 | 33 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 386 | Calf raw | 70 8 | 141 | 19 0 | 4 9 | 4 0 | 0 | 1 3 | 6 | 343 | 10 6 | 22500 | 0 21 | 3 12 | 16 1 | 36 |
| 387 | Chicken, raw | 69 6 | 141 | 22 1 | 4 0 | 2 6 | 0 | 1 7 | 16 | 240 | 7 4 | 32200 | 0 20 | 2 46 | 11 8 | 20 |
| 388 | Pork, raw | 72 3 | 134 | 19 7 | 4 8 | 1 7 | 0 | 1 5 | 10 | 362 | 18 0 | 14200 | 0 40 | 2 98 | 16 7 | 23 |
| 389 | Sheep or lamb, raw | 70 8 | 136 | 21 0 | 3 9 | 2 9 | 0 | 1 4 | 8 | 364 | 12 6 | 50500 | 0 40 | 3 28 | 16 9 | 33 |
| 390 | Liver, canned, strained (infant food) | 77 8 | 108 | 16 0 | 3 9 | 1 0 | 0 | 1 3 | 24 | 278 | 7 1 | 19200 | 0 04 | 2 14 | 6 4 | |
| | Liver sausage See *Sausage* | | | | | | | | | | | | | | | |
| | Liverwurst See *Sausage, liver* | | | | | | | | | | | | | | | |
| | Lobster | | | | | | | | | | | | | | | |
| 391 | Raw | 79 2 | 88 | 16 2 | 1 9 | 0 5 | 0 | 2 2 | 61 | 184 | 0 6 | | (0 13) | 0 06 | (1 9) | |
| 392 | Canned | 77 2 | 92 | 18 4 | 1 3 | 0 4 | 0 | 2 7 | 65 | 192 | 0 8 | | (0 03) | 0 07 | (2 2) | |
| 393 | Loganberries, raw | 82 9 | 62 | 1 0 | 0 6 | 15 0 | 1 4 | 0 5 | 35 | 19 | 1 2 | (200) | (0 03) | (0 07) | (0 3) | 24 |
| | Macaroni | | | | | | | | | | | | | | | |
| | Unenriched | | | | | | | | | | | | | | | |
| 394 | Dry | 8 6 | 377 | 12 8 | 1 4 | 76 5 | 0 4 | 0 7 | 22 | 165 | 1 5 | (0) | 0 09 | 0 06 | 2 0 | (0) |
| 395 | *Cooked | 60 6 | 149 | 5 1 | 0 6 | 30 2 | 0 2 | 3 5 | 9 | 65 | 0 6 | (0) | 0 02 | 0 02 | 0 5 | (0) |
| | Enriched | | | | | | | | | | | | | | | |
| 396 | Dry | 8 6 | 377 | 12 8 | 1 4 | 76 5 | 0 4 | 0 7 | 22 | 165 | 2 9† | (0) | 0 88† | 0 37† | 6 0† | (0) |
| 397 | *Cooked | 60 6 | 149 | 5 1 | 0 6 | 30 2 | 0 2 | 3 5 | 9 | 65 | 1 1 | (0) | 0 17 | 0 10 | 1 4 | (0) |
| 398 | *Macaroni and cheese, baked | 58 1 | 211 | 8 1 | 11 0 | 19 7 | 0 1 | 3 1 | 191 | 169 | 0 5‡ | 450 | 0 03‡ | 0 16‡ | 0 4‡ | Trace |
| | Mackerel | | | | | | | | | | | | | | | |
| 399 | Raw, common Atlantic | 68 1 | 188 | 18 7 | 12 0 | 0 | 0 | 1 2 | 5 | 239 | 1 0 | (450) | 0 15 | 0 35 | 8 4 | |
| | §Canned, solids and liquid | | | | | | | | | | | | | | | |
| 400 | Atlantic | 66 0 | 182 | 19 3 | 11 1 | 0 | 0 | 3 2 | 185 | 274 | 2 1 | 430 | 0 06 | 0 21 | 5 8 | |
| 401 | Pacific | 66 4 | 180 | 21 1 | 10 0 | 0 | 0 | 2 5 | 260 | 288 | 2 2 | 30 | 0 03 | 0 33 | 8 8 | |
| 402 | Mangos, raw | 81 4 | 66 | 0 7 | 0 2 | 17 2 | 1 0 | 0 5 | 9 | 13 | 0 2 | 6350 | 0 06 | 0 06 | 0 9 | 41 |
| 403 | Margarine | 15 5 | 720 | 0 6 | 81 0 | 0 4 | 0 | 2 5 | 20 | 16 | 0 0 | 3300/ | | | | (0) |
| | Marmalades See *Jams, marmalades, preserves* | | | | | | | | | | | | | | | |
| | Mayonnaise See *Salad dressings* | | | | | | | | | | | | | | | |
| | Meat See *Beef, Lamb Pork Veal* | | | | | | | | | | | | | | | |
| | Melons See *Cantaloups, Honeydew, Watermelons* | | | | | | | | | | | | | | | |

* Indicates values calculated from a recipe parentheses indicate imputed value

□ Values for raw items are from the medium fat wholesale cuts considered to be nearest approximations for indicated retail items

† Iron, thiamine, riboflavin and niacin are based on the minimum level of enrichment specified in the standards of identity promulgated under the Food, Drug, and Cosmetic Act

‡ If enriched macaroni is used in the recipe, the values for iron thiamine, riboflavin, and niacin would be 0 7 mg , 0 10 mg , 0 20 mg , and 0 9 mg , respectively

§ The vitamin values are based on the drained solids

/ Based on the average vitamin A content of fortified margarine Most of the margarines manufactured for use in the United States have 15 000 I U of vitamin A dded per pound The minimum Federal specifications for fortified margarine require the addition of 9,000 I U of vitamin A per pound

**Table 144 Composition of Foods, 100 Grams, Edible Portion (Continued)**

| No. | Food and Description | Water (%) | Food Energy (Cal) | Protein (Gm) | Fat (Gm) | Carbohydrate (Gm) | | Ash (Gm) | Calcium (Mg) | Phosphorus (Mg) | Iron (Mg) | Vitamin A Value (I U) | Thiamine (Mg) | Riboflavin (Mg) | Niacin (Mg) | Ascorbic Acid (Mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Total | Fiber | | | | | | | | | |
| | Milk, cow | | | | | | | | | | | | | | | |
| | Fluid (pasteurized and raw) | | | | | | | | | | | | | | | |
| 404 | Whole | 87.0 | 68 | 3.5 | 3.9 | 4.9 | 0 | 0.7 | 118 | 93 | 0.1 | (160) | 0.04 | 0.17 | 0.1 | 1 |
| 405 | Nonfat (skim) | 90.5 | 36 | 3.5 | 0.1 | 5.1 | 0 | 0.8 | 123 | 97 | 0.1 | Trace | 0.04 | 0.18 | 0.1 | 1 |
| | Canned | | | | | | | | | | | | | | | |
| 406 | Evaporated (unsweetened) | 73.7 | 138 | 7.0 | 7.9 | 9.9 | 0 | 1.5 | 243 | 195 | 0.2 | 400 | 0.05 | 0.36 | 0.2 | 1 |
| 407 | Condensed (sweetened) | 27.0 | 320 | 8.1 | 8.4 | 54.8 | 0 | 1.7 | 273 | 228 | 0.2 | (430) | 0.05 | 0.39 | 0.2 | 1 |
| | Dried | | | | | | | | | | | | | | | |
| 408 | Whole | 3.5 | 492 | 25.8 | 26.7 | 38.0 | 0 | 6.0 | 949 | 728 | 0.6 | 1400 | 0.30 | 1.46 | 0.7 | 6 |
| 409 | Nonfat solids (skim) | 3.5 | 362 | 35.6 | 1.0 | 52.0 | 0 | 7.9 | 1300 | 1030 | 0.6 | (40) | 0.35 | 1.96 | 1.1 | 7 |
| | †Malted | | | | | | | | | | | | | | | |
| 410 | Dry powder | 2.6 | 407 | 14.6 | 8.5 | 70.7 | 0.3 | 3.6 | 287 | 379 | 2.1 | 1020 | 0.33 | 0.54 | | (0) |
| 411 | *Beverage | 78.2 | 104 | 4.6 | 4.4 | 11.8 | 0.0 | 1.0 | 135 | 123 | 0.3 | 250 | 0.07 | 0.21 | | 1 |
| 412 | *Chocolate flavored | 83.0 | 74 | 3.2 | 2.2 | 10.6 | (0) | 0.8 | 109 | 91 | 0.1 | 90 | 0.03 | 0.16 | 0.1 | 1 |
| 413 | Half and half (milk and cream) | 79.7 | 137 | 3.2 | 12.0 | 4.5 | 0 | 0.6 | 108 | 85 | 0.1 | 490 | 0.03 | 0.16 | 0.1 | 1 |
| | Buttermilk. See *Buttermilk* | | | | | | | | | | | | | | | |
| | Whey, fluid See *Whey* | | | | | | | | | | | | | | | |
| | Whey, dried See *Whey* | | | | | | | | | | | | | | | |
| 414 | Milk, goat, fluid | 87.4 | 67 | 3.3 | 4.0 | 4.6 | 0 | 0.7 | 129 | 106 | 0.1 | (160) | 0.04 | 0.11 | 0.3 | 1 |
| | *Molasses, cane* | | | | | | | | | | | | | | | |
| 415 | First extraction or light | 24.0 | 252 | | | 65.0‡ | | 6.3§ | 165 | 45 | 4.3 | | 0.07 | 0.06 | 0.2 | |
| 416 | Second extraction or medium | 24.0 | 232 | | | 60.0‡ | | 8.5§ | 290 | 69 | 6.0 | | | | | |
| 417 | Third extraction or blackstrap | 24.0 | 213 | | | 55.0‡ | | 10.5§ | 579 | 85 | 11.3 | | 0.28 | 0.25 | 2.1 | |
| 418 | Barbados | 24.0 | 271 | | | 70.0‡ | | 1.6§ | | 50 | | | 0.06 | 0.20 | | |
| | *Muffins made with | | | | | | | | | | | | | | | |
| 419 | Unenriched flour | 37.4 | 280 | 8.0 | 8.4 | 42.1 | 0.1 | 2.2 | 206 | 191 | 0.6 | 100 | 0.05 | 0.13 | 0.4 | (0) |
| 420 | Enriched flour | 37.4 | 280 | 8.0 | 8.4 | 42.1 | 0.1 | 2.2 | 206 | 191 | 1.6 | 100 | 0.18 | 0.21 | 1.5 | (0) |
| 421 | Mung bean sprouts, raw | 92.4 | 23 | 2.9 | 0.2 | 4.1 | 0.7 | 0.4 | 29 | 59 | 0.8 | 10 | 0.07 | 0.09 | 0.5 | 15 |
| | Mushrooms | | | | | | | | | | | | | | | |
| 422 | Raw | 91.1 | 16 | 2.4 | 0.3 | 4.0 | 0.9 | 1.1 | 9 | 115 | 1.0 | 0 | 0.10 | 0.44 | 4.9 | 5 |
| 423 | Canned solids and liquid | 93.0 | 11 | 1.4 | 0.2 | 3.7 | | 1.0 | (7) | (90) | (0.8) | 0 | 0.02 | 0.25 | 2.0 | |
| | Muskmelons See *Cantaloups and Honeydew melon* | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mustard greens | | | | | | | | | | | | | | | |
| 424 | Raw | 92 2 | 22 | 2 3 | 0 3 | 4 0 | 0 8 | 1 2 | 220 | 38 | 2 9 | 6460 | 0 09 | 0 20 | 0 8 | 102 |
| 425 | Cooked | 92 2 | 22 | 2 3 | 0 3 | 4 0 | 0 8 | 1 2 | 220 | 38 | 2 9 | 7180 | 0 06 | 0 18 | 0 7 | 45 |
| | Noodles (containing egg) | | | | | | | | | | | | | | | |
| | Unenriched | | | | | | | | | | | | | | | |
| 426 | Dry | 9 6 | 381 | 12 6 | 3 4 | 73 2 | 0 4 | 1 2 | 22 | 199 | 2 1 | 200 | 0 20 | 0 11 | 2 3 | (0) |
| 427 | *Cooked | 83 8 | 67 | 2 2 | 0 6 | 12 8 | 0 1 | 0 6 | 4 | 35 | 0 4 | 30 | 0 03 | 0 02 | 0 4 | (0) |
| | Enriched | | | | | | | | | | | | | | | |
| 428 | Dry | 9 6 | 381 | 12 6 | 3 4 | 73 2 | 0 4 | 1 2 | 22 | 199 | 2 9/ | 200 | 0 88/ | 0 37/ | 6 0/ | (0) |
| 429 | *Cooked | 83 8 | 67 | 2 2 | 0 6 | 12 8 | 0 1 | 0 6 | 4 | 35 | 0 5 | 30 | 0 14 | 0 06 | 1 0 | (0) |
| 430 | Oat cereal, ready to-eat (added vitamins and minerals) | 4 0 | 396 | 14 5 | 7 0 | 70 2 | 2 0 | 4 3 | 160 | 350 | 4 1 | (0) | 0 82 | 0 19 | 1 9 | (0) |
| | Oatmeal or rolled oats | | | | | | | | | | | | | | | |
| 431 | Dry | 8 3 | 390 | 14 2 | 7 4 | 68 2 | 1 2 | 1 9 | 53 | 405 | 4 5 | (0) | 0 60 | 0 14 | 1 0 | (0) |
| 432 | *Cooked | 84 8 | 63 | 2 3 | 1 2 | 11 0 | 0 2 | 0 7 | 9 | 67 | 0 7 | (0) | 0 10 | 0 02 | 0 2 | (0) |
| 433 | Precooked (infant food), dry | 6 6 | 375 | 15 0 | 5 0 | 68 7 | 1 5 | 4 7 | 792 | 798 | 31 5 | (0) | 1 26 | 0 35 | 2 3■ | (0) |
| 434 | Oils, salad or cooking | 0 0 | 884 | 0 0 | 100 0 | 0 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Okra | | | | | | | | | | | | | | | |
| 435 | Raw | 89 8 | 32 | 1 8 | 0 2 | 7 4 | 1 0 | 0 8 | 82 | 62 | 0 7 | 740 | 0 08 | 0 07 | 1 1 | 30 |
| 436 | Cooked | 89 8 | 32 | 1 8 | 0 2 | 7 4 | 1 0 | 0 8 | 82 | 62 | 0 7 | 740 | 0 06 | 0 06 | 0 8 | 20 |
| | Oleomargarine See *Margarine* | | | | | | | | | | | | | | | |
| | Olives, pickled | | | | | | | | | | | | | | | |
| 437 | Green | 75 2 | 132 | 1 5 | 13 5 | 4 0 | 1 2 | 5 8 | 87 | 17 | 1 6 | 300 | Trace | | | |
| | Ripe | | | | | | | | | | | | | | | |
| 438 | Mission | 71 8 | 191 | 1 8 | 21 0 | 2 6 | 1 5 | 2 8 | 87 | 17 | 1 6 | 60 | Trace | Trace | | |
| 439 | Other varieties (as ascalano, manzanilla, and sevilano) | 79 8 | 128 | 1 2 | 13 5 | 3 1 | 1 7 | 2 4 | 87 | 17 | 1 6 | 60 | Trace | Trace | | |
| | Omelet. See *Eggs omelet* | | | | | | | | | | | | | | | |
| | Onions, mature | | | | | | | | | | | | | | | |
| 440 | Raw | 87 5 | 45 | 1 4 | 0 2 | 10 3 | 0 8 | 0 6 | 32 | 44 | 0 5 | 50 | 0 03 | 0 04 | 0 2 | 9 |
| 441 | Cooked | 89 5 | 38 | 1 0 | 0 2 | 8 7 | 0 8 | 0 6 | 32 | 44 | 0 5 | 50 | 0 02 | 0 03 | 0 2 | 6 |
| 442 | Dehydrated flaked | 4 0 | 347 | 10 8 | 1 1 | 80 2 | 4 5 | 3 9 | 168 | 273 | 3 4 | 130 | 0 25 | 0 18 | 1 4 | 36 |
| 443 | Onions, young, green | 87 6 | 45 | 1 0 | 0 2 | 10 6 | 1 8 | 0 6 | 135 | 24 | 0 9 | (50) | (0 03) | (0 04) | (0 2) | 24 |
| 444 | Oranges | 87 2 | 45 | 0 9 | 0 2 | 11 2 | 0 6 | 0 5 | 33 | 23 | 0 4 | (190) | 0 08 | 0 03 | 0 2 | 49 |

* Indicates values calculated from a recipe, parentheses indicate imputed value

† Based on unfortified products

‡ Total sugars

§ Sulfated ash This overestimates the ash in the range of 8 to 20 per cent

/ Iron, thiamine, riboflavin, and niacin are based on the minimum level of enrichment specified in the standards of identity promulgated under the Food, Drug, and Cosmetic Act

■ Based on products ranging from 1 4 to 4 3 mg per 100 gm of cereal The niacin value of some products is as high as 22 8 mg per 100 gm

## Table 144 Composition of Foods, 100 Grams, Edible Portion (Continued)

| No. | Food and Description | Water (%) | Food Energy (Cal) | Protein (Gm) | Fat (Gm) | Carbohydrate (Gm) Total | Carbohydrate (Gm) Fiber | Ash (Gm) | Calcium (Mg) | Phosphorus (Mg) | Iron (Mg) | Vitamin A Value (IU) | Thiamine (Mg) | Riboflavin (Mg) | Niacin (Mg) | Ascorbic Acid (Mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Orange juice | | | | | | | | | | | | | | | |
| 445 | Fresh | 87 5 | 44 | 0 8 | 0 2 | 11 0 | 0 1 | 0 4 | 19 | 16 | 0 2 | (190) | 0 08 | 0 03 | 0 2 | 49 |
| | Canned | | | | | | | | | | | | | | | |
| 446 | Unsweetened | 87 5 | 44 | 0 8 | 0 2 | 11 1 | 0 1 | 0 4 | 10 | 18 | 0 3 | (100) | 0 07 | 0 02 | 0 2 | 42 |
| 447 | *Sweetened* | 84 8 | 54 | 0 6 | 0 2 | 13 9 | 0 1 | 0 5 | 10 | 18 | 0 3 | (100) | 0 07 | 0 02 | 0 2 | 42 |
| | Orange juice concentrate | | | | | | | | | | | | | | | |
| 448 | Canned | 35 0 | 229 | 4 2 | 0 7 | 58 0 | 0 2 | 2 1 | 61 | 89 | 1 6 | (510) | 0 37 | 0 08 | 1 1 | 221 |
| 449 | Frozen | 58 0 | 149 | 2 7 | 0 7 | 37 1 | 0 2 | 1 5 | 34 | 60 | 1 0 | (330) | 0 24 | 0 05 | 0 7 | 141 |
| 450 | Oysters, meat only, raw | 80 5 | 84 | 9 8 | 2 1 | 5 6 | | 2 0 | 94 | 143 | 5 6 | 320 | 0 15 | 0 20 | 1 2 | |
| | *Oyster stew | | | | | | | | | | | | | | | |
| 451 | 1 part oysters to 3 parts milk by volume | 82 6 | 91 | 5 3 | 5 4 | 5 3 | | 1 4 | 117 | 110 | 1 5 | 280 | 0 06 | 0 18 | 0 4 | |
| 452 | 1 part oysters to 1 part milk by volume | 79 9 | 102 | 6 9 | 5 5 | 5 9 | | 1 8 | 109 | 122 | 2 9 | 340 | 0 09 | 0 19 | 0 7 | |
| | *Pancakes (griddlecakes), baked | | | | | | | | | | | | | | | |
| | Wheat (home recipe) | | | | | | | | | | | | | | | |
| 453 | With unenriched flour | 55 4 | 218 | 6 8 | 9 2 | 26 6 | 0 1 | 2 0 | 158 | 154 | 0 6 | 200 | 0 06 | 0 13 | 0 3 | Trace |
| 454 | With enriched flour | 55 4 | 218 | 6 8 | 9 2 | 26 6 | 0 1 | 2 0 | 158 | 154 | 1 3 | 200 | 0 18 | 0 21 | 1 3 | Trace |
| 455 | Buckwheat, with buckwheat pancake mix | 62 0 | 176 | 6 1 | 8 4 | 20 9 | 0 5 | 2 6 | 249 | 362 | 1 2 | 110 | 0 16 | 0 16 | 0 9 | Trace |
| | Pancake mix dry, self rising | | | | | | | | | | | | | | | |
| | Wheat (mixed with other flours) | | | | | | | | | | | | | | | |
| 456 | Unenriched | 10 4 | 349 | 9 5 | 1 4 | 73 1 | 0 4 | 5 6 | 465 | 681 | 2 0 | 0 | 0 14 | 0 07 | 1 4 | (0) |
| 457 | Enriched | 10 4 | 349 | 9 5 | 1 4 | 73 1 | 0 4 | 5 6 | 465 | 681 | 3 3 | 0 | 0 39 | 0 31 | 2 9 | (0) |
| 458 | Buckwheat | 11 2 | 319 | 10 5 | 1 9 | 70 3 | 1 4 | 6 1 | 467 | 827 | 3 1 | 0 | 0 37 | 0 11 | 2 2 | (0) |
| 459 | Papayas raw | 88 7 | 39 | 0 6 | 0 1 | 10 0 | 0 9 | 0 6 | 20 | 16 | 0 3 | 1750 | 0 03 | 0 04 | 0 3 | 56 |
| 460 | Parsley common, raw | 83 9 | 50 | 3 7 | 1 0 | 9 0 | 1 8 | 2 4 | 193† | 84 | 4 3 | 8230 | 0 11 | 0 28 | 1 4 | 193 |
| | Parsnips | | | | | | | | | | | | | | | |
| 461 | Raw | 78 6 | 78 | 1 5 | 0 5 | 18 2 | 2 2 | 1 2 | 57 | 80 | 0 7 | 0 | 0 08 | 0 12 | 0 2 | 18 |
| 462 | Cooked | 83 5 | 60 | 1 0 | 0 5 | 13 9 | 2 1 | 1 1 | 57 | 80 | 0 7 | 0 | 0 06 | 0 10 | 0 2 | 12 |
| | Pastry, shell, plain See *Pie crust* | | | | | | | | | | | | | | | |
| | Peaches | | | | | | | | | | | | | | | |
| 463 | Raw | 86 9 | 46 | 0 5 | 0 1 | 12 0 | 0 6 | 0 5 | 8 | 22 | 0 6 | 880 | 0 02 | 0 05 | 0 9 | 8 |
| | Canned solids and liquid | | | | | | | | | | | | | | | |
| 464 | Water pack | 92 3 | 27 | 0 5 | 0 1 | 6 8 | 0 3 | 0 3 | 5 | 14 | 0 4 | 450 | 0 01 | 0 02 | 0 7 | 4 |
| 465 | Sirup pack | 80 9 | 68 | 0 4 | 0 1 | 18 2 | 0 4 | 0 4 | 5 | 14 | 0 4 | 450 | 0 01 | 0 02 | 0 7 | 4 |
| 466 | Strained (infant food) | 83 5 | 60 | 0 8 | 0 3 | 15 1 | 0 4 | 0 3 | 7 | 19 | 0 9 | 630 | 0 02 | 0 02 | 0 6 | 3 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 467 | *Frozen* | 78.9 | 78 | 0.4 | 0.1 | 20.2 | 0.4 | 0.4 | 6 | 15 | 0.4 | 520 | 0.01 | 0.03 | 0.5 | 4 |
| | *Dried sulfured* | | | | | | | | | | | | | | | |
| 468 | Uncooked | 24.0 | 265 | 3.0 | 0.6 | 69.4 | 3.5 | 3.0 | 44 | 126 | 6.9 | 3250 | 0.01 | 0.20 | 5.4 | 19 |
| 469 | *Cooked, no sugar added | 76.2 | 83 | 0.9 | 0.2 | 21.8 | 1.1 | 0.9 | 14 | 39 | 2.2 | 1020 | Trace | 0.06 | 1.6 | 4 |
| 470 | *Cooked, sugar added | 66.9 | 120 | 0.8 | 0.2 | 31.3 | 1.0 | 0.8 | 12 | 35 | 1.9 | 900 | Trace | 0.05 | 1.4 | 4 |
| 471 | Peanuts, Virginia type, roasted, shelled | 2.6 | 559 | 26.9 | 44.2 | 23.6 | 2.4 | 2.7 | 74 | 393 | 1.9 | 0 | 0.30 | 0.13 | 16.2 | (0) |
| 472 | Peanut butter | 1.7 | 576 | 26.1 | 47.8 | 21.0 | 2.0 | 3.4 | 74 | 393 | 1.9 | 0 | 0.12 | 0.13 | 16.2 | (0) |
| | Pears | | | | | | | | | | | | | | | |
| 473 | Raw | 82.7 | 63 | 0.7 | 0.4 | 15.8 | 1.4 | 0.4 | 13 | 16 | 0.3 | 20 | 0.02 | 0.04 | 0.1 | 4 |
| | Canned, solids and liquid | | | | | | | | | | | | | | | |
| 474 | Water pack | 91.2 | 31 | 0.3 | 0.1 | 8.2 | 0.7 | 0.2 | 8 | 10 | 0.2 | Trace | 0.01 | 0.02 | 0.1 | 2 |
| 475 | Sirup pack | 81.1 | 68 | 0.2 | 0.1 | 18.4 | 0.8 | 0.2 | 8 | 10 | 0.2 | Trace | 0.01 | 0.02 | 0.1 | 2 |
| 476 | Strained (infant food) | 85.7 | 51 | 0.7 | 0.2 | 13.1 | 1.1 | 0.3 | 11 | 13 | (0.2) | 40 | 0.01 | 0.02 | 0.2 | 1 |
| | Peas, green, immature | | | | | | | | | | | | | | | |
| 477 | Raw | 74.3 | 98 | 6.7 | 0.4 | 17.7 | 2.2 | 0.9 | 22 | 122 | 1.9 | 680 | 0.34 | 0.16 | 2.7 | 26 |
| 478 | Cooked | 81.7 | 70 | 4.9 | 0.4 | 12.1 | 2.2 | 0.9 | 22 | 122 | 1.9 | 720 | 0.25 | 0.14 | 2.3 | 15 |
| | Canned | | | | | | | | | | | | | | | |
| 479 | Solids and liquid | 82.3 | 68 | 3.4 | 0.4 | 12.9 | 1.4 | 1.0 | 25 | 67 | 1.8 | 540 | 0.11 | 0.06 | 1.0 | 8 |
| 480 | Drained solids | 76.7 | 91 | 4.5 | 0.6 | 17.2 | 2.3 | 1.0 | 32 | 77 | 2.1 | 670 | 0.12 | 0.06 | 1.0 | 9 |
| 481 | Strained (infant food) | 86.9 | 49 | 4.1 | 0.3 | 7.9 | 1.0 | 0.8 | 16 | 62 | 1.4 | 630 | 0.09 | 0.08 | 1.1 | 8 |
| 482 | Frozen | 80.3 | 75 | 5.7 | 0.3 | 12.9 | 1.9 | 0.8 | 17 | 94 | 1.5 | 670 | 0.33 | 0.11 | 1.9 | 18 |
| | Peas, mature dry seeds | | | | | | | | | | | | | | | |
| 483 | Entire seeds | 11.6 | 339 | 23.8 | 1.4 | 60.2 | 5.4 | 3.0 | 57 | 388 | 4.7 | 370 | 0.77 | 0.28 | 3.1 | 2 |
| 484 | Split, without seed coat | 10.0 | 344 | 24.5 | 1.0 | 61.7 | 1.2 | 2.8 | 33 | 268 | 5.1 | 370 | 0.77 | 0.28 | 3.1 | 2 |
| | Pea soup, dehydrated See *Soups, dehydrated* | | | | | | | | | | | | | | | |
| 485 | Pecans | 3.0 | 696 | 9.4 | 73.0 | 13.0 | 2.2 | 1.6 | 74 | 324 | 2.4 | 50 | 0.72 | 0.11 | 0.9 | 2 |
| | Peppers, green | | | | | | | | | | | | | | | |
| 486 | Raw | 92.4 | 25 | 1.2 | 0.2 | 5.7 | 1.4 | 0.5 | 11 | 25 | 0.4 | 630 | 0.04 | 0.07 | 0.4 | 120 |
| 487 | Cooked, parboiled then baked | 91.9 | 26 | 1.3 | 0.2 | 6.0 | 1.6 | 0.6 | 11 | 25 | 0.4 | 740 | 0.04 | 0.07 | 0.4 | 99 |
| 488 | Persimmons, Japanese or Kaki, raw | 78.2 | 78 | 0.8 | 0.4 | 20.0 | 1.9 | 0.6 | 6 | 26 | 0.3 | 2710 | 0.05 | 0.05 | Trace | 11 |
| | Pickles | | | | | | | | | | | | | | | |
| 489 | Dill, cucumber | 93.2 | 11 | 0.7 | 0.2 | 2.1 | 0.4 | 3.8 | 25 | 20 | 1.2 | 310 | Trace | 0.06 | Trace | 6 |
| 490 | Fresh, cucumber (as bread and butter pickles) | 79.5 | 70 | 0.9 | 0.2 | 17.0 | | 2.4 | 32 | 27 | 1.8 | 180 | 0.02 | 0.04 | Trace | 9 |
| 491 | Sour, cucumber or mixed | 95.1 | 11 | 0.5 | 0.2 | 2.2 | 0.4 | 2.0 | 25 | 20 | 1.2 | 310 | Trace | 0.06 | Trace | 6 |
| 492 | Sweet, cucumber or mixed | 70.5 | 108 | 0.8 | 0.4 | 26.4 | | 1.9 | 16 | 18 | 1.3 | 110 | (0) | 0.02 | Trace | 7 |
| | Pies | | | | | | | | | | | | | | | |
| 493 | *Apple | 47.8 | 246 | 2.1 | 9.5 | 39.5 | 0.7 | 1.1 | 7 | 24 | 0.4 | 160 | 0.03 | 0.02 | 0.2 | 1 |
| 494 | *Blueberry | 52.7 | 216 | 2.1 | 6.9 | 37.5 | 0.7 | 0.8 | 10 | 22 | 0.5 | 120 | 0.02 | 0.03 | 0.2 | 4 |

* Indicates values calculated from a recipe, parentheses indicate imputed value
† Calcium may not be available because of presence of oxalic acid

Table 144 Composition of Foods, 100 Grams, Edible Portion (Continued)

| No. | Food and Description | Water (%) | Food Energy (Cal) | Protein (Gm) | Fat (Gm) | Carbohydrate (Gm) Total | Carbohydrate (Gm) Fiber | Ash (Gm) | Calcium (Mg) | Phosphorus (Mg) | Iron (Mg) | Vitamin A Value (I U) | Thiamine (Mg) | Riboflavin (Mg) | Niacin (Mg) | Ascorbic Acid (Mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pies (Continued) | | | | | | | | | | | | | | | |
| 495 | *Cherry | 46.2 | 253 | 2.4 | 9.8 | 40.4 | 0.2 | 1.2 | 10 | 27 | 0.4 | 380 | 0.03 | 0.02 | 0.2 | 1 |
| 496 | Coconut custard | 58.5 | 204 | 5.2 | 8.7 | 26.3 | 0.0 | 1.3 | 125 | 116 | 1.2 | 230 | 0.05 | 0.16 | 0.3 | (0) |
| 497 | Custard | 58.5 | 204 | 5.2 | 8.7 | 26.3 | 0.0 | 1.3 | 125 | 116 | 1.2 | 230 | 0.05 | 0.16 | 0.3 | (0) |
| 498 | Lemon meringue | 47.4 | 252 | 3.6 | 10.1 | 37.4 | 0.0 | 1.5 | 20 | 51 | 0.5 | 170 | 0.03 | 0.08 | 0.2 | 1 |
| 499 | Mince† | 43.0 | 252 | 2.5 | 6.9 | 45.6 | 0.5 | 2.0 | 16 | 40 | 2.2 | 10 | 0.07 | 0.04 | 0.4 | 1 |
| 500 | *Pumpkin | 58.9 | 202 | 4.2 | 9.6 | 25.8 | 0.6 | 1.5 | 54 | 81 | 0.8 | 1910 | 0.03 | 0.12 | 0.3 | (0) |
| | *Pie crust, plain | | | | | | | | | | | | | | | |
| | Baked with | | | | | | | | | | | | | | | |
| 501 | Unenriched flour | 9.7 | 487 | 7.5 | 26.9 | 53.1 | 0.2 | 2.8 | 11 | 65 | 0.5 | 0 | 0.03 | 0.02 | 0.5 | (0) |
| 502 | Enriched flour | 9.7 | 487 | 7.5 | 26.9 | 53.1 | 0.2 | 2.8 | 11 | 65 | 2.0 | 0 | 0.22 | 0.17 | 2.2 | (0) |
| 503 | Unbaked (fresh or frozen) | 20.5 | 429 | 6.6 | 23.7 | 46.7 | 0.2 | 2.5 | 9 | 57 | 0.4 | 0 | 0.04 | 0.02 | 0.5 | (0) |
| 504 | Pimentos, canned | 92.4 | 27 | 0.9 | 0.5 | 5.8 | 0.6 | 0.4 | 7 | 17 | 1.5 | 2300 | 0.02 | 0.06 | 0.4 | 95 |
| | Pineapple | | | | | | | | | | | | | | | |
| 505 | Raw | 85.3 | 52 | 0.4 | 0.2 | 13.7 | 0.4 | 0.4 | 16 | 11 | 0.3 | 130 | 0.08 | 0.02 | 0.2 | 24 |
| 506 | Canned, sirup pack, solids and liquid | 78.0 | 78 | 0.4 | 0.1 | 21.1 | 0.3 | 0.4 | 29 | 7 | 0.6 | 80 | 0.07 | 0.02 | 0.2 | 9 |
| 507 | Frozen | 76.8 | 86 | 0.4 | 0.2 | 22.2 | 0.4 | 0.4 | 14 | 10 | 0.3 | 100 | 0.06 | 0.02 | 0.2 | 19 |
| 508 | Pineapple juice canned | 86.2 | 49 | 0.3 | 0.1 | 13.0 | 0.1 | 0.4 | 15 | 8 | 0.5 | 80 | 0.05 | 0.02 | 0.2 | 9 |
| 509 | Plantain or baking banana raw | 66.4 | 119 | 1.1 | 0.4 | 31.2 | 0.4 | 0.9 | 7 | 30 | 0.7 | ‡ | 0.06 | 0.04 | 0.6 | 14 |
| 510 | Plums (all, excluding prunes), raw | 85.7 | 50 | 0.7 | 0.2 | 12.9 | 0.5 | 0.5 | 17 | 20 | 0.5 | 350 | 0.06 | 0.04 | 0.5 | 5 |
| | Plums (Italian prunes) canned | | | | | | | | | | | | | | | |
| 511 | Sirup pack, solids and liquid (except pits) | 78.6 | 76 | 0.4 | 0.1 | 20.4 | 0.3 | 0.5 | 8 | 12 | 1.1 | 230 | 0.03 | 0.03 | 0.4 | 1 |
| | Popcorn | | | | | | | | | | | | | | | |
| 512 | Unpopped | 9.8 | 362 | 11.9 | 4.7 | 72.1 | 2.1 | 1.5 | (10) | (264) | (2.5) | (0) | (0.39) | (0.11) | (2.1) | (0) |
| 513 | Popped | 4.0 | 386 | 12.7 | 5.0 | 76.7 | 2.2 | 1.6 | (11) | (281) | (2.7) | (0) | (0.39) | (0.12) | (2.2) | (0) |
| | Pork, fresh | | | | | | | | | | | | | | | |
| | Packer's carcass side, raw | | | | | | | | | | | | | | | |
| 514 | Thin | 50.0 | 376 | 14.1 | 35.0 | 0 | 0 | 0.8 | 8 | 151 | 2.1 | (0) | 0.69 | 0.16 | 3.7 | 0 |
| 515 | Medium | 42.0 | 457 | 11.9 | 45.0 | 0 | 0 | 0.6 | 7 | 117 | 1.8 | (0) | 0.58 | 0.14 | 3.1 | 0 |
| 516 | Fat | 35.0 | 538 | 9.8 | 55.0 | 0 | 0 | 0.5 | 6 | 84 | 1.5 | (0) | 0.48 | 0.12 | 2.6 | 0 |
| | Retail items § medium fat | | | | | | | | | | | | | | | |
| | Ham. | | | | | | | | | | | | | | | |
| 517 | Raw | 53.0 | 344 | 15.2 | 31.0 | 0 | 0 | 0.8 | 9 | 168 | 2.3 | (0) | 0.74 | 0.18 | 4.0 | 0 |
| 518 | Cooked | 42.0 | 400 | 24.0 | 33.0 | 0 | 0 | 1.2 | 11 | 238 | 3.1 | (0) | 0.53 | 0.24 | 4.7 | 0 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Loin or chops* | | | | | | | | | | | | | | | |
| 519 | *Raw* | 58 0 | 296 | 16 4 | 25 0 | 0 | 0 | 0 9 | 10 | 186 | 2 5 | (0) | 0 80 | 0 19 | 4 3 | 0 |
| 520 | *Cooked* | 50 0 | 333 | 23 0 | 26 0 | 0 | 0 | 1 2 | 11 | 235 | 3 0 | (0) | 0 83 | 0 24 | 5 0 | 0 |
| 521 | Miscellaneous lean cuts raw | 52 0 | 357 | 14 5 | 32 7 | 0 | 0 | 0 8 | 8 | 157 | 2 2 | (0) | 0 70 | 0 17 | 3 8 | 0 |
| | Pork, cured | | | | | | | | | | | | | | | |
| | Ham, smoked § medium fat | | | | | | | | | | | | | | | |
| 522 | Raw | 42 0 | 389 | 16 9 | 35 0 | (0 3) | 0 | 5 4 | 10 | 136 | 2 5 | (0) | 0 70 | 0 19 | 4 0 | 0 |
| 523 | Cooked | 39 0 | 397 | 23 0 | 33 0 | (0 4) | 0 | 5 4 | 10 | 166 | 2 9 | (0) | 0 54 | 0 21 | 4 2 | 0 |
| | Luncheon meat | | | | | | | | | | | | | | | |
| 524 | Boiled ham | 47 8 | 302 | 22 8 | 22 7 | 0 | 0 | 6 7 | 9 | 92 | 2 7 | (0) | 1 01 | 0 26 | 5 1 | 0 |
| 525 | Canned, spiced | 55 2 | 289 | 14 9 | 24 3 | 1 5 | 0 2 | 4 1 | 9 | 161 | 2 2 | (0) | 0 32 | 0 22 | 2 8 | 0 |
| 526 | Salt pork, fat, raw | 8 0 | 783 | 3 9 | 85 0 | 0 | (0) | 3 5 | Trace | Trace | 0 6 | (0) | (0 18) | (0 04) | (0 9) | 0 |
| | Sausage, pork links or bulk, raw See *Sausage, pork* | | | | | | | | | | | | | | | |
| 527 | Pork, canned, strained (infant food) | 75 7 | 127 | 17 1 | 6 0 | 0 | 0 | 1 2 | 14 | 180 | 1 7 | (0) | 0 35 | 0 28 | 4 7 | 0 |
| | Potatoes | | | | | | | | | | | | | | | |
| 528 | Raw | 77 8 | 83 | 2 0 | 0 1 | 19 1 | 0 4 | 1 0 | 11 | 56 | 0 7 | 20 | 0 11 | 0 04 | 1 2 | 17/ |
| | Cooked | | | | | | | | | | | | | | | |
| 529 | Baked | 73 8 | 98 | 2 4 | 0 1 | 22 5 | 0 5 | 1 2 | 13 | 66 | 0 8 | 20 | 0 11 | 0 05 | 1 4 | 17 |
| 530 | Boiled, unpeeled | 77 8 | 83 | 2 0 | 0 1 | 19 1 | 0 4 | 1 0 | 11 | 56 | 0 7 | 20 | 0 10 | 0 04 | 1 2 | 15 |
| 531 | Boiled peeled before cooking | 77 8 | 83 | 2 0 | 0 1 | 19 1 | 0 4 | 1 0 | 11 | 56 | 0 7 | 20 | 0 09 | 0 03 | 1 0 | 14 |
| 532 | *French fried | 19 6 | 393 | 5 4 | 19 1 | 52 0 | 1 1 | 3 9 | 30 | 152 | 1 9 | 50 | 0 18 | 0 11 | 3 3 | 28 |
| 533 | *Fried raw | 43 0 | 282 | 3 8 | 14 2 | 36 3 | 0 8 | 2 7 | 21 | 106 | 1 3 | 40 | 0 12 | 0 08 | 2 3 | 19 |
| 534 | *Hash browned after holding overnight | 50 7 | 241 | 3 3 | 11 7 | 31 9 | 0 7 | 2 4 | 18 | 93 | 1 2 | 30 | 0 08 | 0 06 | 1 7 | 7 |
| 535 | *Mashed, milk added | 78 4 | 81 | 2 2 | 0 7 | 17 0 | 0 3 | 1 7 | 27 | 62 | 0 6 | 40 | 0 08 | 0 05 | 0 9 | 7 |
| 536 | *Mashed milk and butter added | 74 2 | 123 | 2 1 | 6 0 | 15 9 | 0 3 | 1 8 | 27 | 59 | 0 6 | 260 | 0 08 | 0 05 | 0 8 | 7 |
| 537 | Steamed or pressure-cooked | 77 8 | 83 | 2 0 | 0 1 | 19 1 | 0 4 | 1 0 | 11 | 56 | 0 7 | 20 | 0 10 | 0 04 | 1 2 | 14 |
| | Canned | | | | | | | | | | | | | | | |
| 538 | ‡ Solids and liquid | 84 6 | 58 | 1 7 | 0 0 | 13 1 | 0 3 | 0 6 | 8 | 39 | 0 5 | 10 | 0 06 | 0 03 | 0 8 | 9 |
| 539 | Drained solids | 77 8 | 83 | 2 0 | 0 1 | 19 1 | 0 4 | 1 0 | 11 | 56 | 0 7 | 20 | 0 08 | 0 03 | 0 9 | 13 |
| 540 | Dehydrated | 7 0 | 357 | 7 1 | 0 7 | 82 2 | 2 2 | 3 0 | 25 | 88 | 4 0 | 40 | 0 30 | 0 11 | 4 5 | 23 |
| 541 | Potato chips | 3 1 | 544 | 6 7 | 37 1 | 49 1 | (1 1) | 4 0 | (30) | (152) | (1 9) | (50) | (0 18) | (0 11) | (3 2) | 11 |
| 542 | Potato flour | 7 0 | 357 | 7 1 | 0 7 | 82 2 | 2 2 | 3 0 | 25 | 88 | 4 0 | 40 | 0 30 | 0 11 | 4 5 | 23 |
| 543 | Pretzels | 8 0 | 369 | 8 8 | 3 2 | 74 5 | 0 3 | 5 5 | (12) | (71) | (0 7) | (0) | (0 01) | (0 04) | (0 7) | (0) |

* Indicates values calculated from a recipe, parentheses indicate imputed value.
† The proximate constituents, calcium, phosphorus, and vitamin A, are calculated from a recipe
‡ The vitamin A values range from about 10 I U per 100 gm of white fleshed plantains to 1200 I U per 100 gm of deeper yellow fleshed varieties
§ Values for raw items are from the medium fat wholesale cuts considered to be nearest approximations for indicated retail items
/ Year round average Recently dug potatoes contain about 24 mg of ascorbic acid per 100 gm The value is only half as high after 3 months of storage and about one third as high when potatoes have been stored as long as six months

**Table 144. Composition of Foods, 100 Grams, Edible Portion (Continued)**

| | Food and Description | Water (%) | Food Energy (Cal) | Protein (Gm) | Fat (Gm) | Carbohydrate (Gm) Total | Carbohydrate (Gm) Fiber | Ash (Gm) | Calcium (Mg) | Phosphorus (Mg) | Iron (Mg) | Vitamin A Value (I U) | Thiamine (Mg) | Riboflavin (Mg) | Niacin (Mg) | Ascorbic Acid (Mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Prunes, dried, unsulfured | | | | | | | | | | | | | | | |
| 544 | Uncooked | 24.0 | 268 | 2.3 | 0.6 | 71.0 | 1.6 | 2.1 | 54 | 85 | 3.9 | 1890 | 0.10 | 0.16 | 1.7 | 3 |
| 545 | *Cooked, no sugar added | 64.6 | 125 | 1.1 | 0.3 | 33.0 | 0.8 | 1.0 | 25 | 40 | 1.8 | 890 | 0.03 | 0.08 | 0.8 | 1 |
| 546 | *Cooked, sugar added | 54.7 | 165 | 1.0 | 0.2 | 43.2 | 0.6 | 0.9 | 22 | 34 | 1.5 | 750 | 0.03 | 0.06 | 0.6 | 1 |
| | See also Plums (Italian prunes), canned | | | | | | | | | | | | | | | |
| 547 | Prunes, canned, strained (infant food) | 72.6 | 97 | 1.1 | 0.2 | 25.4 | 0.7 | 0.7 | 26 | 29 | 1.5 | 730 | 0.03 | 0.05 | 0.6 | 3 |
| 548 | Prune juice, canned | 80.0 | 71 | 0.4 | 0 | 19.3 | | 0.3 | (25) | (40) | (1.8) | | (0.03) | (0.08) | 0.4 | (1) |
| 549 | *Prune whip | 58.7 | 148 | 2.8 | 0.3 | 37.1 | 0.7 | 1.1 | 26 | 42 | 1.8 | 860 | 0.04 | 0.11 | 0.7 | 2 |
| | Pudding, vanilla See *Blanc mange* | | | | | | | | | | | | | | | |
| | Pumpkin | | | | | | | | | | | | | | | |
| 550 | Raw | 90.5 | 31 | 1.2 | 0.2 | 7.3 | 1.3 | 0.8 | 21 | 44 | 0.8 | (3400) | (0.05) | (0.08) | (0.6) | 8 |
| 551 | Canned | 90.2 | 33 | 1.0 | 0.3 | 7.9 | 1.2 | 0.6 | (20) | (36) | (0.7) | 3400 | 0.02 | 0.06 | 0.5 | |
| 552 | Radishes, raw | 93.6 | 20 | 1.2 | 0.1 | 4.2 | 0.7 | 1.0 | 37 | 31 | 1.0 | 30 | 0.03 | 0.02 | 0.3 | 24 |
| | Raisins, unsulfured | | | | | | | | | | | | | | | |
| 553 | Dried | 24.0 | 268 | 2.3 | 0.5 | 71.2 | | 2.0 | 78 | 129 | 3.3 | 50 | 0.15 | 0.08 | 0.5 | Trace |
| 554 | *Cooked, sugar added, fruit and liquid | 46.6 | 194 | 1.1 | 0.2 | 51.1 | | 1.0 | 38 | 63 | 1.6 | 20 | 0.06 | 0.04 | 0.2 | Trace |
| | Raspberries | | | | | | | | | | | | | | | |
| 555 | Black, raw | 80.6 | 74 | 1.5 | 1.6 | 15.7 | 6.8 | 0.6 | 40 | 37 | 0.9 | 0 | 0.02 | (0.07) | (0.3) | (24) |
| | Red | | | | | | | | | | | | | | | |
| 556 | Raw | 84.1 | 57 | 1.2 | 0.4 | 13.8 | 4.7 | 0.5 | 40 | 37 | 0.9 | 130 | 0.02 | (0.07) | (0.3) | 24 |
| 557 | Frozen | 73.9 | 98 | 0.8 | 0.3 | 24.7 | 3.3 | 0.3 | 28 | 26 | 0.6 | 80 | 0.01 | (0.04) | (0.2) | 16 |
| | Rhubarb, stems only | | | | | | | | | | | | | | | |
| 558 | Raw | 94.9 | 16 | 0.5 | 0.1 | 3.8 | 0.7 | 0.7 | 51† | 25 | 0.5 | 30 | 0.01 | | 0.1 | 9 |
| 559 | *Cooked, sugar added | 62.9 | 141 | 0.4 | 0.1 | 36.0 | 0.6 | 0.6 | 41† | 20 | 0.4 | 20 | 0.01 | | 0.1 | 6 |
| | Canned in sirup See *Cooked* | | | | | | | | | | | | | | | |
| | Rice | | | | | | | | | | | | | | | |
| 560 | Brown, raw | 12.0 | 360 | 7.5 | 1.7 | 77.7 | 0.6 | 1.1 | 39 | 303 | 2.0 | (0) | 0.32 | 0.05 | 4.6 | (0) |
| | Converted | | | | | | | | | | | | | | | |
| 561 | Raw | 12.3 | 362 | 7.6 | 0.3 | 79.4 | 0.2 | 0.4 | 24 | 136 | 0.8 | (0) | 0.20 | 0.03 | 3.8 | (0) |
| 562 | *Cooked | 71.5 | 116 | 2.4 | 0.1 | 25.4 | 0.1 | 0.6 | 8 | 43 | 0.3 | (0) | 0.05 | 0.01 | 1.1 | (0) |
| | White or milled | | | | | | | | | | | | | | | |
| 563 | Raw | 12.3 | 362 | 7.6 | 0.3 | 79.4 | 0.2 | 0.4 | 24 | 136 | 0.8 | (0) | 0.07 | 0.03 | 1.6 | (0) |
| 564 | *Cooked | 70.5 | 119 | 2.5 | 0.1 | 26.2 | 0.1 | 0.7 | 8 | 45 | 0.3 | (0) | 0.01 | 0.01 | 0.4 | (0) |
| 565 | Precooked, dry | 7.6 | 382 | 8.8 | 0.2 | 83.3 | 0.4 | 0.1 | 4 | 66 | 0.8 | (0) | 0.02 | 0.02 | 0.1 | (0) |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rice products | | | | | | | | | | | | | | | |
| 566 | Flakes | 3.5 | 392 | 5.9 | 0.6 | 87.7 | 0.5 | 2.3 | 21 | 116 | 1.8 | (0) | 0.08 | 0.08 | 0.9 | (0) |
| 567 | Flakes (added thiamine and niacin) | 3.5 | 392 | 5.9 | 0.6 | 87.7 | 0.5 | 2.3 | 21 | 116 | 1.8 | (0) | 0.46 | 0.08 | 5.5 | (0) |
| 568 | Puffed | 3.5 | 392 | 5.9 | 0.6 | 87.7 | 0.5 | 2.3 | 21 | 116 | 1.8 | (0) | 0.08 | 0.08 | 0.9 | (0) |
| 569 | Puffed (added thiamine and niacin) | 3.5 | 392 | 5.9 | 0.6 | 87.7 | 0.5 | 2.3 | 21 | 116 | 1.8 | (0) | 0.46 | 0.08 | 5.5 | (0) |
| | Rice, wild See *Wild rice* | | | | | | | | | | | | | | | |
| | *Rolls | | | | | | | | | | | | | | | |
| | Plain | | | | | | | | | | | | | | | |
| 570 | Unenriched (pan rolls) | 28.5 | 309 | 9.0 | 5.5 | 55.1 | 0.2 | 1.9 | 55 | 96 | 0.7 | 0 | 0.06 | 0.11 | 1.0 | (0) |
| 571 | Enriched (pan rolls) | 28.5 | 309 | 9.0 | 5.5 | 55.1 | 0.2 | 1.9 | 55 | 96 | 1.8‡ | 0 | 0.24‡ | 0.15‡ | 2.2‡ | (0) |
| | Sweet | | | | | | | | | | | | | | | |
| 572 | Unenriched | 28.4 | 323 | 8.5 | 7.8 | 53.8 | 0.2 | 1.5 | 63 | 104 | 0.6 | 0 | 0.05 | 0.13 | 1.0 | (0) |
| 573 | Enriched | 28.4 | 323 | 8.5 | 7.8 | 53.8 | 0.2 | 1.5 | 63 | 104 | 1.8‡ | 0 | 0.24‡ | 0.15‡ | 2.2‡ | (0) |
| | Rutabagas | | | | | | | | | | | | | | | |
| 574 | Raw | 89.1 | 38 | 1.1 | 0.1 | 8.9 | 1.3 | 0.8 | 55 | 41 | 0.4 | 330 | 0.07 | 0.08 | 0.9 | 36 |
| 575 | Cooked | 90.8 | 32 | 0.8 | 0.1 | 7.5 | 1.4 | 0.8 | 55 | 41 | 0.4 | 350 | 0.05 | 0.07 | 0.7 | 21 |
| | Rye bread See *Breads* | | | | | | | | | | | | | | | |
| | Rye flour | | | | | | | | | | | | | | | |
| 576 | Light | 11.0 | 358 | 9.4 | 1.0 | 77.9 | 0.4 | 0.7 | 22 | 185 | 1.1 | (0) | 0.15 | 0.07 | 0.6 | (0) |
| 577 | Medium | 11.0 | 350 | 11.4 | 1.7 | 74.8 | 1.0 | 1.1 | (27) | 262 | 2.6 | (0) | 0.30 | 0.12 | 2.5 | (0) |
| 578 | Dark | 11.0 | 330 | 16.3 | 2.6 | 68.1 | 2.4 | 2.0 | 54 | (536) | 4.5 | (0) | 0.61 | 0.22 | 2.7 | (0) |
| 579 | Rye meal or whole grain | 11.0 | 334 | 12.1 | 1.7 | 73.4 | 2.0 | 1.8 | (38) | 376 | 3.7 | (0) | 0.43 | 0.22 | 1.6 | (0) |
| 580 | Rye wafers or "Swedish health bread" | 6.5 | 338 | 12.4 | 1.2 | 75.3 | 2.1 | 4.6 | 50 | 400 | 4.4 | (0) | 0.32 | 0.20 | 1.2 | (0) |
| | Salad dressings | | | | | | | | | | | | | | | |
| 581 | Commercial, plain (mayonnaise type)§ | 44.7 | 384 | 1.1 | 36.8 | 13.9 | (0) | 3.5 | 9 | 30 | 0.4 | 140 | 0.02 | 0.03 | (0) | 0 |
| 582 | French | 39.6 | 394 | 0.6 | 35.5 | 20.3 | 0.3 | 4.0 | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) |
| 583 | *Home cooked boiled | 68.0 | 165 | 4.5 | 10.0 | 15.0 | 0 | 2.5 | 90 | 102 | 0.7 | 500 | 0.06 | 0.17 | 0.3 | Trace |
| 584 | Mayonnaise§ | 16.0 | 708 | 1.5 | 78.0 | 3.0 | (0) | 1.5 | 19 | 60 | 1.0 | 210 | 0.04 | 0.04 | (0) | 0 |
| | Salad oil See *Oils salad or cooking* | | | | | | | | | | | | | | | |
| | Salmon | | | | | | | | | | | | | | | |
| 585 | Raw Pacific (Chinook or King) | 63.4 | 223 | 17.4 | 16.5 | 0 | 0 | 1.0 | | (289) | (0.9) | 310 | 0.10 | 0.23 | 7.2 | 9 |
| 586 | Cooked Pacific, broiled or baked | 64.5 | 170 | 28.0 | 5.6 | 0.2 | 0 | 1.7 | | (417) | (1.2) | | 0.10 | 0.28 | 8.1 | |

* Indicates values calculated from a recipe parentheses indicate imputed value

† Calcium may not be available because of presence of oxalic acid

‡ Iron, thiamine, riboflavin and niacin are based on the minimum level of enrichment specified in the standards of identity of breads proposed by the Federal Security gency and published in the Federal Register, August 3, 1943

§ *Minerals and vitamins are calculated from a recipe*

**Table 144 Composition of Foods, 100 Grams, Edible Portion (Continued)**

| No. | Food and Description | Water (%) | Food Energy (Cal) | Protein (Gm) | Fat (Gm) | Carbohydrate (Gm) Total | Carbohydrate (Gm) Fiber | Ash (Gm) | Calcium (Mg) | Phosphorus (Mg) | Iron (Mg) | Vitamin A Value (I U) | Thiamine (Mg) | Riboflavin (Mg) | Niacin (Mg) | Ascorbic Acid (Mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Soups, dehydrated | | | | | | | | | | | | | | | |
| 636 | Navy bean† | 7.0 | 327 | 17.6 | 1.2 | 62.9 | 3.5 | 11.3 | 134 | 425 | 9.2 | 0 | 0.42 | 0.19 | 2.2 | 1 |
| 637 | Pea‡ | 7.0 | 328 | 20.4 | 1.1 | 61.0 | 1.1 | 10.5 | 67 | 364 | 5.4 | 220 | 0.57 | 0.19 | 3.1 | 1 |
| 638 | Soybeans, whole, mature, dried | 7.5 | 331 | 34.9 | 18.1 | 34.8§ | 5.0 | 4.7 | 227 | 586 | 8.0 | 110 | 1.07 | 0.31 | 2.3 | Trace |
| 639 | Soybean curd | 85.1 | 71 | 7.0 | 4.1 | 3.0 | 0.1 | 0.8 | 100 | 95 | 1.5 | | 0.06 | 0.05 | 0.4 | (0) |
| | Soybean flour, flakes, grits | | | | | | | | | | | | | | | |
| 640 | Low fat | 11.0 | 228 | 44.7 | 1.1 | 37.7§ | 2.3 | 5.5 | 265 | 623 | 13.0 | 70 | 1.10 | 0.35 | 2.9 | (0) |
| 641 | Medium fat | 9.0 | 264 | 42.5 | 6.5 | 37.2§ | 2.6 | 4.8 | 244 | 610 | 13.0 | 110 | 0.82 | 0.34 | 2.6 | (0) |
| 642 | Full fat | 9.0 | 347 | 35.9 | 20.6 | 29.9§ | 2.3 | 4.6 | 195 | 553 | 12.1 | 140 | 0.77 | 0.28 | 2.2 | (0) |
| 643 | Soybean milk (without added calcium and vitamins) | 92.5 | 33 | 3.4 | 1.5 | 2.1 | 0.0 | 0.5 | 21 | 47 | 0.7 | | 0.09 | 0.04 | 0.3 | (0) |
| 644 | Soybean sprouts, raw | 86.3 | 46 | 6.2 | 1.4 | 5.3 | 0.8 | 0.8 | 48 | 67 | 1.0 | 180 | 0.23 | 0.20 | 0.8 | 13 |
| | Spaghetti | | | | | | | | | | | | | | | |
| | Unenriched | | | | | | | | | | | | | | | |
| 645 | Dry | 8.6 | 377 | 12.8 | 1.4 | 76.5 | 0.4 | 0.7 | 22 | 165 | 1.5 | (0) | 0.09 | 0.06 | 2.0 | (0) |
| 646 | *Cooked | 60.6 | 149 | 5.1 | 0.6 | 30.2 | 0.2 | 3.5 | 9 | 65 | 0.6 | (0) | 0.02 | 0.02 | 0.5 | (0) |
| | Enriched | | | | | | | | | | | | | | | |
| 647 | Dry | 8.6 | 377 | 12.8 | 1.4 | 76.5 | 0.4 | 0.7 | 22 | 165 | 2.9/ | (0) | 0.88/ | 0.37/ | 6.0/ | (0) |
| 648 | *Cooked | 60.6 | 149 | 5.1 | 0.6 | 30.2 | 0.2 | 3.5 | 9 | 65 | 1.1 | (0) | 0.17 | 0.10 | 1.4 | (0) |
| | Spinach | | | | | | | | | | | | | | | |
| 649 | Raw | 92.7 | 20 | 2.3 | 0.3 | 3.2 | 0.6 | 1.5 | 81■ | 55 | 3.0 | 9420 | 0.11 | 0.20 | 0.6 | 59 |
| 650 | Cooked | 90.8 | 26 | 3.1 | 0.6 | 3.6 | 1.0 | 1.9 | 124■ | 33 | 2.0 | 11780 | 0.08 | 0.20 | 0.6 | 30 |
| | Canned | | | | | | | | | | | | | | | |
| 651 | Solids and liquid | 92.3 | 20 | 2.3 | 0.4 | 3.0 | 0.7 | 1.8 | 90■ | 33 | 1.6 | 6790 | 0.02 | 0.10 | 0.3 | 14 |
| 652 | Drained solids | 90.8 | 26 | 3.1 | 0.6 | 3.6 | 1.0 | 1.9 | 124■ | 33 | 2.0 | 7630 | 0.02 | 0.12 | 0.4 | 14 |
| 653 | Strained (infant food) | 93.6 | 17 | 1.9 | 0.4 | 2.6 | 0.6 | 1.5 | 77■ | 40 | 1.4 | 4200 | 0.02 | 0.11 | 0.3 | 7 |
| 654 | Frozen | 92.7 | 20 | 2.3 | 0.3 | 3.2 | 0.6 | 1.5 | 81■ | 55 | 3.0 | 6820 | 0.07 | 0.17 | 0.5 | 38 |
| | Squash, summer | | | | | | | | | | | | | | | |
| 655 | Raw | 95.0 | 16 | 0.6 | 0.1 | 3.9 | 0.5 | 0.4 | 15 | 15 | 0.4 | 260 | 0.05 | 0.09 | 0.8 | 17 |
| 656 | Cooked, diced | 95.0 | 16 | 0.6 | 0.1 | 3.9 | 0.5 | 0.4 | 15 | 15 | 0.4 | 260 | 0.04 | 0.07 | 0.6 | 11 |
| 657 | Frozen | 95.0 | 16 | 0.6 | 0.1 | 3.9 | 0.5 | 0.4 | 15 | 15 | 0.4 | 220 | 0.04 | 0.08 | 0.7 | 11 |
| | Squash, winter | | | | | | | | | | | | | | | |
| 658 | Raw | 88.6 | 38 | 1.5 | 0.3 | 8.8 | 1.4 | 0.8 | 19 | 28 | 0.6 | 4950 | 0.05 | 0.12 | 0.5 | 8 |
| 659 | Cooked, baked, mashed | 85.7 | 47 | 1.9 | 0.4 | 11.0 | 1.8 | 1.0 | 24 | 35 | 0.8 | 6190 | 0.05 | 0.15 | 0.6 | 7 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 660 | Cooked, boiled, mashed | 88 6 | 38 | 1 5 | 0 3 | 8 8 | 1 4 | 0 8 | 19 | 28 | 0 6 | 4950 | 0 04 | 0 10 | 0 4 | 5 |
| 661 | Canned, strained (infant food) | 91 0 | 28 | 1 1 | 0 2 | 6 7 | 0 7 | 1 0 | 31 | 19 | 0 4 | 1960 | 0 02 | 0 06 | (0 4) | 4 |
| 662 | Starch, pure (including arrowroot, corn, etc ) | 12 0 | 362 | 0 5 | 0 2 | 87 0 | 0 1 | 0 3 | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) |
| | Strawberries | | | | | | | | | | | | | | | |
| 663 | Raw | 89 9 | 37 | 0 8 | 0 5 | 8 3 | 1 4 | 0 5 | 28 | 27 | 0 8 | 60 | 0 03 | 0 07 | 0 3 | 60 |
| 664 | *Frozen* | 72 0 | 106 | 0 6 | 0 4 | 26 6 | 1 1 | 0 4 | 22 | 22 | 0 6 | 40 | 0 02 | 0 05 | 0 2 | 41 |
| | Sugars | | | | | | | | | | | | | | | |
| 665 | Granulated, cane or beet | 0 5 | 385 | (0) | (0) | 99 5 | (0) | | | | | (0) | (0) | (0) | (0) | (0) |
| 666 | Powdered | 0 5 | 385 | (0) | (0) | 99 5 | (0) | | | | | (0) | (0) | (0) | (0) | (0) |
| 667 | Brown | 3 0 | 370 | (0) | (0) | 95 5 | | 1 2 | 76▲ | 37▲ | 2 6 | (0) | (0) | (0) | (0) | (0) |
| 668 | Corn sugar, unrefined | 7 5 | 348 | | | (90) | | 0 3 | | | | (0) | (0) | (0) | (0) | (0) |
| | Dextrose (including refined corn sugar) | | | | | | | | | | | | | | | |
| 669 | Anhydrous | 0 5 | 385 | (0) | (0) | 99 5 | (0) | | | | | (0) | (0) | (0) | (0) | (0) |
| 670 | Crystallized | 10 0 | 348 | (0) | (0) | 90 0 | (0) | | | | | (0) | (0) | (0) | (0) | (0) |
| 671 | Maple | 7 5 | 348 | | | (90) | | 0 9 | | | | | | | | |
| | Sweet potatoes ◻ | | | | | | | | | | | | | | | |
| 672 | Raw | 68 5 | 123 | 1 8 | 0 7 | 27 9 | 1 0 | 1 1 | 30 | 49 | 0 7 | 7700 | 0 09 | 0 05 | 0 6 | 22 |
| | Cooked | | | | | | | | | | | | | | | |
| 673 | Baked | 61 1 | 152 | 2 2 | 0 9 | 34 4 | 1 2 | 1 4 | 37 | 60 | 0 9 | 9510 | 0 10 | 0 06 | 0 8 | 23 |
| 674 | Boiled | 68 5 | 123 | 1 8 | 0 7 | 27 9 | 1 0 | 1 1 | 30 | 49 | 0 7 | 7700 | 0 09 | 0 05 | 0 6 | 20 |
| 675 | Candied | 57 4 | 179 | 1 5 | 3 6 | 36 2 | 0 8 | 1 3 | 36 | 45 | 0 9 | 6250 | 0 04 | 0 04 | 0 5 | 9 |
| 676 | Canned, vacuum or solid pack | 71 9 | 107 | 2 0 | 0 1 | 25 0 | 1 0 | 1 0 | 25 | 41 | 0 8 | 8850 | 0 05 | 0 04 | 0 5 | 14 |
| 677 | Dehydrated | 7 0 | 362 | 5 0 | 0 9 | 84 5 | 3 1 | 2 6 | 75 | 74 | 2 3 | 19980 | 0 21 | 0 14 | 1 9 | 32 |
| | Swordfish | | | | | | | | | | | | | | | |
| 678 | Raw | 75 8 | 118 | 19 2 | 4 0 | 0 | 0 | 1 3 | 19 | 195 | 0 9 | 1580 | 0 05 | 0 05 | 9 1 | |
| 679 | Cooked, broiled | 64 8 | 178 | 27 4 | 6 8 | 0 | 0 | 1 7 | 20 | 251 | 1 1 | 2300 | 0 05 | 0 06 | 10 3 | (0) |
| 680 | Tangerines (including other Mandarin type oranges) | 87 3 | 44 | 0 8 | 0 3 | 10 9 | 1 0 | 0 7 | (33) | (23) | (0 4) | (420) | 0 07 | (0 03) | (0 2) | 31 |

* Indicates values calculated from a recipe, parentheses indicate imputed value

† Navy bean meal with farinaceous flour up to 15 per cent

‡ Pea meal with farinaceous flour up to 15 per cent

§ Approximately 40 per cent of this total amount of carbohydrate calculated by difference is sugar, starch, and dextrin The remaining portion is made up of materials thought to be utilized only poorly, if at all, by the body

/ Iron, thiamine, riboflavin, and niacin are based on the minimum level of enrichment specified in the standards of identity promulgated under the Food, Drug, and Cosmetic Act

■ Calcium may not be available because of presence of oxalic acid

▲ Calcium and phosphorus are based on dark brown sugar values would be lower for light brown sugar

◻ If very pale varieties only were used, the vitamin A value would be much lower

**Table 144. Composition of Foods, 100 Grams, Edible Portion (Continued)**

| | Food and Description | Water (%) | Food Energy (Cal) | Protein (Gm) | Fat (Gm) | Carbohydrate (Gm) Total | Carbohydrate (Gm) Fiber | Ash (Gm) | Calcium (Mg) | Phosphorus (Mg) | Iron (Mg) | Vitamin A Value (I U) | Thiamine (Mg) | Riboflavin (Mg) | Niacin (Mg) | Ascorbic Acid (Mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Tangerine juice, unsweetened | | | | | | | | | | | | | | | |
| 681 | Fresh | 89.2 | 39 | 0.9 | 0.3 | 9.2 | | 0.4 | 19 | 16 | (0.2) | (420) | 0.07 | (0.03) | 0.2 | 31 |
| 682 | Canned | 89.2 | 39 | 0.9 | 0.3 | 9.2 | | 0.4 | 19 | 16 | 0.2 | (420) | (0.06) | (0.03) | (0.2) | (26) |
| 683 | Tapioca, dry | 12.6 | 360 | 0.6 | 0.2 | 86.4 | 0.1 | 0.2 | 12 | 12 | (1.0) | (0) | (0) | (0) | (0) | (0) |
| | Tomatoes | | | | | | | | | | | | | | | |
| 684 | Raw | 94.1 | 20 | 1.0 | 0.3 | 4.0 | 0.6 | 0.6 | 11 | 27 | 0.6 | 1100 | 0.06 | 0.04 | 0.5 | 23 |
| 685 | Canned or cooked | 94.2 | 19 | *1.0* | 0.2 | 3.9 | *0.4* | *0.7* | *(11)* | *(27)* | *(0.6)* | *1050* | 0.06 | 0.03 | 0.7 | 16 |
| 686 | Tomato juice, canned | 93.5 | 21 | 1.0 | 0.2 | 4.3 | 0.2 | 1.0 | (7) | (15) | (0.4) | 1050 | 0.05 | 0.03 | 0.8 | 16 |
| 687 | Tomato catsup | 69.5 | 98 | 2.0 | 0.4 | 24.5 | 0.4 | 3.6 | 12 | 18 | 0.8 | (1880) | 0.09 | 0.07 | 2.2 | 11 |
| 688 | Tomato flakes | 3.0 | 340 | 10.8 | 3.3 | 76.7 | 6.5 | 6.2 | 119 | 293 | 6.5 | 3720 | 0.65 | 0.43 | 6.5 | 114 |
| 689 | Tomato purée, canned | 89.2 | 36 | 1.8 | 0.5 | 7.2 | 0.4 | 1.3 | (11) | (37) | (1.1) | 1880 | 0.09 | 0.07 | 1.8 | 28 |
| | Tomato soup See *Soups, canned, tomato* | | | | | | | | | | | | | | | |
| 690 | Tongue, beef, medium fat, raw | 68.0 | 207 | 16.4 | 15.0 | 0.4 | (0) | 0.9 | 9 | 187 | 2.8 | (0) | 0.12 | 0.29 | 5.0 | (0) |
| 691 | Tortillas | 41.9 | 211 | 5.8 | (2.8) | 48.6 | (1.4) | 0.9 | 111 | 184 | 2.2 | 210‡ | 0.19 | 0.06 | 1.0 | |
| | Tuna fish, canned | | | | | | | | | | | | | | | |
| 692 | Solids and liquid | 52.5 | 290 | 23.8 | 20.9 | 0 | 0 | 2.3 | 7 | 294 | 1.2 | (220) | (0.04) | (0.10) | (10.8) | (0) |
| 693 | Drained solids | 60.0 | 198 | 29.0 | 8.2 | 0 | 0 | 2.7 | (8) | (351) | 1.4 | 80 | 0.05 | 0.12 | 12.8 | (0) |
| 694 | Turkey, medium fat, raw | 58.3 | 268 | 20.1 | 20.2 | 0 | 0 | 1.0 | 23 | 320 | 3.8 | Trace | 0.09 | 0.14 | 8.0 | (0) |
| | Turnips | | | | | | | | | | | | | | | |
| 695 | Raw | 90.9 | 32 | 1.1 | 0.2 | 7.1 | 1.1 | 0.7 | 40 | 34 | 0.5 | Trace | 0.05 | 0.07 | 0.5 | 28 |
| 696 | Cooked | 92.3 | 27 | 0.8 | 0.2 | 6.0 | 1.2 | 0.7 | 40 | 34 | 0.5 | Trace | 0.04 | 0.06 | 0.4 | 18 |
| | *Turnip greens* | | | | | | | | | | | | | | | |
| 697 | Raw | 89.5 | 30 | 2.9 | 0.4 | 5.4 | 1.2 | 1.8 | 259 | 50 | 2.4 | 9540 | 0.09 | 0.46 | 0.8 | 136 |
| | Cooked | | | | | | | | | | | | | | | |
| 698 | Boiled in small amount of water until tender | 89.5 | 30 | 2.9 | 0.4 | 5.4 | 1.2 | 1.8 | 259 | 50 | 2.4 | 10600 | 0.06 | 0.41 | 0.7 | 60 |
| 699 | Boiled in large amount of water, long time | 89.5 | 30 | 2.9 | 0.4 | 5.4 | 1.2 | 1.8 | 259 | 50 | 2.4 | 10600 | 0.05 | 0.36 | 0.6 | 45 |
| 700 | Canned, solids and liquid | 93.7 | 18 | 1.5 | 0.3 | 3.2 | 0.7 | 1.3 | 100 | 30 | 1.6 | 4400 | 0.02 | 0.09 | 0.6 | 20 |
| | Veal | | | | | | | | | | | | | | | |
| | Carcass or side excluding kidney fat, raw | | | | | | | | | | | | | | | |
| 701 | Thin | 71.0 | 156 | 19.7 | 8.0 | 0 | 0 | 1.0 | 11 | 201 | 3.0 | (0) | 0.14 | 0.26 | 6.6 | 0 |
| 702 | Medium fat | 68.0 | 190 | 19.1 | 12.0 | 0 | 0 | 1.0 | 11 | 193 | 2.9 | (0) | 0.14 | 0.25 | 6.4 | 0 |
| 703 | Fat | 65.0 | 223 | 18.5 | 16.0 | 0 | 0 | 0.9 | 11 | 185 | 2.8 | (0) | 0.14 | 0.25 | 6.2 | 0 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Retail items,† medium fat | | | | | | | | | | | | | | | |
| | Cutlet, boned (wholesale round) | | | | | | | | | | | | | | | |
| 704 | Raw | 70.0 | 164 | 19.5 | 9.0 | 0 | 0 | 1.0 | 11 | 200 | 2.9 | (0) | 0.14 | 0.26 | 6.5 | 0 |
| 705 | Cooked | 60.0 | 219 | 28.0 | 11.0 | 0 | 0 | 1.4 | 12 | 258 | 3.5 | (0) | 0.08▲ | 0.28▲ | 6.1▲ | 0 |
| | Shoulder roast, boned (wholesale chuck) | | | | | | | | | | | | | | | |
| 706 | Raw | 70.0 | 173 | 19.4 | 10.0 | 0 | 0 | 1.0 | 11 | 199 | 2.9 | (0) | 0.14 | 0.26 | 6.5 | 0 |
| 707 | Cooked | 59.0 | 228 | 28.0 | 12.0 | 0 | 0 | 1.4 | 12 | 258 | 3.6 | (0) | 0.13 | 0.31 | 7.9 | 0 |
| | *Stew meat, without bone | | | | | | | | | | | | | | | |
| 708 | Raw | 64.0 | 231 | 18.3 | 17.0 | 0 | 0 | 0.9 | 11 | 182 | 2.7 | (0) | 0.13 | 0.24 | 6.1 | 0 |
| 709 | Cooked | 53.0 | 296 | 25.0 | 21.0 | 0 | 0 | 0.8 | 11 | 124 | 3.0 | (0) | 0.05§ | 0.24§ | 4.6§ | 0 |
| 710 | Veal, canned, strained (infant food) | 81.2 | 84 | 16.0 | 1.7 | 0 | 0 | 1.1 | 14 | 169 | 1.6 | (0) | 0.03 | 0.30 | 5.5 | 0 |
| 711 | Vegetables, mixed, strained, canned (infant food) | 90.5 | 29 | 1.6 | 0.1 | 6.9 | 0.7 | 0.9 | 30 | 34 | 1.0 | / | 0.03 | 0.03 | 0.4 | 3 |
| | Vienna sausage See *Sausage* | | | | | | | | | | | | | | | |
| 712 | Vinegar | | 12 | 0 | | (5.0) | (0) | 0.3 | 7 | 10 | 0.5 | | | | | . |
| | *Waffles, baked | | | | | | | | | | | | | | | |
| 713 | With unenriched flour | 40.0 | 287 | 9.3 | 10.6 | 37.8 | 0.1 | 2.3 | 192 | 204 | 1.0 | 360 | 0.06 | 0.18 | 0.4 | (0) |
| 714 | With enriched flour | 40.0 | 287 | 9.3 | 10.6 | 37.8 | 0.1 | 2.3 | 192 | 204 | 1.8 | 360 | 0.18 | 0.27 | 1.3 | (0) |
| 715 | Walnuts, Persian or English | 3.3 | 654 | 15.0 | 64.4 | 15.6 | 2.1 | 1.7 | 83 | 380 | 2.1 | 30 | 0.48 | 0.13 | 1.2 | 3 |
| | Water cress See *Cress, water* | | | | | | | | | | | | | | | |
| 716 | Watermelons | 92.1 | 28 | 0.5 | 0.2 | 6.9 | 0.6 | 0.3 | 7 | 12 | 0.2 | 590 | 0.05 | 0.05 | 0.2 | 6 |
| | Wheat, whole grain ■ | | | | | | | | | | | | | | | |
| 717 | *Hard red spring* | 13.0 | 330 | 14.0 | 2.2 | 69.1 | 2.3 | 1.7 | 36 | 383 | 3.1 | (0) | 0.57 | 0.12 | 4.3 | (0) |
| 718 | Hard red winter | 12.5 | 330 | 12.3 | 1.8 | 71.7 | 2.3 | 1.7 | 46 | 354 | 3.4 | (0) | 0.52 | 0.12 | 4.3 | (0) |
| 719 | Soft red winter | 14.0 | 326 | 10.2 | 2.0 | 72.1 | 2.3 | 1.7 | 42 | 400 | 3.5 | (0) | 0.43 | 0.11 | (3.6) | (0) |
| 720 | White | 11.5 | 335 | 9.4 | 2.0 | 75.4 | 1.9 | 1.7 | 36 | 394 | 3.0 | (0) | 0.53 | 0.12 | 5.3 | (0) |
| 721 | Durum | 13.0 | 332 | 12.7 | 2.5 | 70.1 | 1.8 | 1.7 | 37 | 386 | 4.3 | (0) | 0.66 | 0.12 | (4.4) | (0) |
| | Wheat flours | | | | | | | | | | | | | | | |
| 722 | Whole (from hard wheats) | 12.0 | 333 | 13.3 | 2.0 | 71.0 | 2.3 | 1.7 | 41 | 372 | 3.3 | (0) | 0.55 | 0.12 | 4.3 | (0) |
| 723 | 80 per cent extraction (from hard wheats) | 12.0 | 365 | 12.0 | 1.3 | 74.1 | 0.5 | 0.65 | 24 | 191 | 1.3 | (0) | 0.26 | 0.07 | 2.0 | (0) |

* Indicates item calculated from a recipe parentheses indicate imputed value

‡ Vitamin A value of tortillas made from yellow corn tortillas made from white corn have no vitamin A value

† Values for raw items are from the medium fat wholesale cuts considered to be nearest approximations for indicated retail items

▲ Data assume cut to be prepared by braising or pot roasting Use of proportionate quantity of drippings would add approximately 50 per cent more thiamine and niacin and 25 per cent more riboflavin

§ *Use of proportionate quantity of* liquid would double amount of thiamine and niacin and add one third more riboflavin

/ Vitamin A values range from 970 to 5340 I U per 100 gm

■ Figures for moisture are based on product as it reaches the mill prior to tempering, other proximate constituents are adjusted to this basis

**Table 144. Composition of Foods, 100 Grams, Edible Portion (Continued)**

| | Food and Description | Water (%) | Food Energy (Cal) | Protein (Gm) | Fat (Gm) | Carbohydrate (Gm) Total | Carbohydrate (Gm) Fiber | Ash (Gm) | Calcium (Mg) | Phosphorus (Mg) | Iron (Mg) | Vitamin A Value (I U) | Thiamine (Mg) | Riboflavin (Mg) | Niacin (Mg) | Ascorbic Acid (Mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wheat flours (Continued) | | | | | | | | | | | | | | | |
| 724 | Straight, hard wheat | 12.0 | 365 | 11.8 | 1.2 | 74.5 | 0.4 | 0.46 | 20 | 97 | 1.4 | (0) | 0.12 | 0.07 | 1.4 | (0) |
| 725 | Straight, soft wheat | 12.0 | 364 | 9.7 | 1.0 | 76.9 | 0.4 | 0.42 | 20 | 97 | 1.1 | (0) | 0.08 | 0.05 | 1.2 | (0) |
| | Self rising | | | | | | | | | | | | | | | |
| 726 | Unenriched | 12.0 | 350 | 9.2 | 1.0 | 73.8 | 0.4 | 4.0 | 272 | 484 | 1.0 | (0) | 0.08 | 0.05 | 1.1 | (0) |
| 727 | Enriched | 12.0 | 350 | 9.2 | 1.0 | 73.8 | 0.4 | 4.0 | 272▲ | 484 | 2.9▲ | (0) | 0.44▲ | 0.26▲ | 3.5▲ | (0) |
| | Patent | | | | | | | | | | | | | | | |
| | All purpose or family flour | | | | | | | | | | | | | | | |
| 728 | Unenriched | 12.0 | 364 | 10.5 | 1.0 | 76.1 | 0.3 | 0.43 | 16 | 87 | 0.8 | (0) | 0.06 | 0.05 | 0.9 | (0) |
| 729 | Enriched | 12.0 | 364 | 10.5 | 1.0 | 76.1 | 0.3 | 0.43 | 16 | 87 | 2.9□ | (0) | 0.44□ | 0.26□ | 3.5□ | (0) |
| | Bread flour | | | | | | | | | | | | | | | |
| 730 | Unenriched | 12.0 | 365 | 11.8 | 1.1 | 74.7 | 0.3 | 0.44 | 16 | 95 | 0.9 | (0) | 0.08 | 0.06 | 1.0 | (0) |
| 731 | Enriched | 12.0 | 365 | 11.8 | 1.1 | 74.7 | 0.3 | 0.44 | 16 | 95 | 2.9□ | (0) | 0.44□ | 0.26□ | 3.5□ | (0) |
| 732 | Cake or pastry flour | 12.0 | 364 | 7.5 | 0.8 | 79.4 | 0.2 | 0.31 | 17 | 73 | 0.5 | (0) | 0.03 | 0.03 | 0.7 | (0) |
| | Wheat products | | | | | | | | | | | | | | | |
| | Bran, breakfast cereals *See Bran* | | | | | | | | | | | | | | | |
| 733 | Flakes | 3.8 | 355 | 10.8 | 1.6 | 80.2 | 1.7 | 3.6 | 46 | 329 | 3.0 | (0) | 0.08 | 0.18 | 4.8 | (0) |
| 734 | Flakes (added iron, thiamine, and niacin) | 3.8 | 355 | 10.8 | 1.6 | 80.2 | 1.7 | 3.6 | 46 | 329 | 4.2 | (0) | 0.56 | 0.18 | 6.4 | (0) |
| 735 | Germ | 11.0 | 361 | 25.2 | 10.0 | 49.5 | 2.5 | 4.3 | 84 | 1096 | 8.1 | (0) | 2.05 | 0.80 | 4.6 | (0) |
| 736 | Puffed | 3.8 | 355 | 10.8 | 1.6 | 80.2 | 1.7 | 3.6 | 46 | 329 | 3.0 | (0) | 0.08 | 0.18 | 4.8 | (0) |
| 737 | Puffed (added iron, thiamine, and niacin) | 3.8 | 355 | 10.8 | 1.6 | 80.2 | 1.7 | 3.6 | 46 | 329 | 4.2 | (0) | 0.56 | 0.18 | 6.4 | (0) |
| | Rolled | | | | | | | | | | | | | | | |
| 738 | Dry | 10.1 | 340 | 9.9 | 2.0 | 76.2 | 2.2 | 1.8 | 36 | 342 | 3.2 | (0) | 0.36 | 0.12 | 4.1 | (0) |
| 739 | *Cooked | 79.7 | 75 | 2.2 | 0.4 | 16.9 | 0.5 | 0.8 | 8 | 76 | 0.7 | (0) | 0.07 | 0.03 | 0.9 | (0) |
| | Shredded | | | | | | | | | | | | | | | |
| 740 | Plain | 5.6 | 360 | 10.1 | 2.5 | 80.1 | 2.3 | 1.7 | 47 | 360 | 3.5 | (0) | 0.22 | 0.12 | 4.4 | (0) |
| 741 | With added malt and sugar | 3.8 | 355 | 8.8 | 1.2 | 82.8 | 2.1 | 3.4 | 50 | 337 | 4.2 | (0) | 0.18† | 0.15 | 4.4 | (0) |
| | Whole meal | | | | | | | | | | | | | | | |
| 742 | Dry | 8.2 | 344 | 12.7 | 1.7 | 75.3 | 2.2 | 2.1 | 46 | 392 | 3.4 | (0) | 0.55 | 0.15 | 4.4 | (0) |
| 743 | *Cooked | 80.3 | 72 | 2.7 | 0.3 | 15.8 | 0.4 | 0.9 | 9 | 83 | 0.7 | (0) | 0.10 | 0.03 | 0.9 | (0) |
| | Whole meal (added wheat germ, iron, and thiamine) | | | | | | | | | | | | | | | |
| 744 | Dry | 11.0 | 336 | 12.8 | 2.0 | 72.4 | 1.8 | 1.8 | 50 | 400 | 30.0 | (0) | 1.50 | 0.16 | 5.2 | (0) |
| 745 | *Cooked | 85.1 | 55 | 2.1 | 0.3 | 11.8 | 0.3 | 0.7 | 8 | 65 | 4.9 | (0) | 0.22 | 0.03 | 0.8 | (0) |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wheat and malted barley cereal See *Break fast foods mixed cereals* | | | | | | | | | | | | | | | |
| | Whey | | | | | | | | | | | | | | | |
| 746 | Flu d | 93 2 | 26 | 0 9 | 0 3 | 5 1 | 0 | 0 5 | 51 | 53 | 0 1 | 10 | 0 04 | 0 15 | 0 1 | |
| 747 | Dried | 6 2 | 344 | 12 5 | 1 2 | 72 4 | 0 | 7 7 | 679 | 576 | | 50 | 0 49 | 2 50 | 0 8 | |
| 748 | *White sauce, medium | 73 5 | 162 | 4 0 | 12 5 | 8 8 | 0 0 | 1 4 | 115 | 95 | 0 1 | 510 | 0 03 | 0 15 | 0 1 | Trace |
| 749 | Wild rice, parched, raw | 8 5 | 353 | 14 1 | 0 7 | 75 3 | 1 0 | 1 4 | 19 | 339 | | (0) | 0 45 | 0 63 | 6 2 | (0) |
| | Yeast | | | | | | | | | | | | | | | |
| 750 | Compressed, baker's | 70 9 | 86 | (10 6) | 0 4 | 13 0 | 0 3 | 2 4 | 25 | 605 | 4 9 | (0) | 0 45 | 2 07 | 28 2 | (0) |
| 751 | Dried, brewer s | 7 0 | 273 | (36 9) | 1 6 | 37 4 | 0 8 | 7 9 | 106 | 1893 | 18 2 | (0) | 9 69 | 5 45 | 36 2 | (0) |

* Indicate values calculated from a recipe parentheses indicate imputed value

[a] Iron thiamine riboflavin, and niacin are based on the minimum level of enrichment specified in the standards of identity promulgated under the Food, Drug, and Cosmetic Act Calcium is based on the level usually found in self rising flour which is in excess of the minimum (500 mg per pound) required

[b] Iron, thiamine riboflavin and niacin are based on the minimum level of enrichment specified in the standards of identity promulgated under the Food, Drug and Cosmetic Act

† For brands that are oven toasted thiamine will be 0 05 mg

**Table 145 Nutrients in Household Quantities of Foods***

| Food and approximate measure or common weight | Water (*Pct.*) | Food energy (*Cal.*) | Protein (*Gm.*) | Fat (*Gm.*) | Total carbohydrate (*Gm.*) | Calcium (*Mg.*) | Iron (*Mg.*) | Vitamin A Value (*I.U.*) | Thiamine (*Mg.*) | Riboflavin (*Mg.*) | Niacin Value (*Mg.*) | Ascorbic acid (*Mg.*) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Milk and milk products* | | | | | | | | | | | | |
| Buttermilk, from skim milk, 1 cup | 90 | 85 | 9 | Tr | 12 | 288 | 0.2 | 10 | 0.09 | 0.43 | 0.3 | 3 |
| Milk, cow | | | | | | | | | | | | |
| Fluid, whole, 1 cup | 87 | 165 | 9 | 10 | 12 | 288 | 0.2 | 390 | 0.09 | 0.42 | 0.3 | 3 |
| Fluid, nonfat (skim), 1 cup | 90 | 85 | 9 | Tr | 13 | 303 | 0.2 | 10 | 0.09 | 0.44 | 0.3 | 3 |
| Evaporated (undiluted), 1 cup | 74 | 345 | 18 | 20 | 25 | 612 | 0.4 | 1010 | 0.12 | 0.91 | 0.5 | 3 |
| Condensed (undiluted), 1 cup | 27 | 980 | 25 | 26 | 168 | 835 | 0.6 | 1300 | 0.16 | 1.19 | 0.6 | 3 |
| Dry, whole, 1 tablespoon | 4 | 40 | 2 | 2 | 3 | 76 | 0 | 110 | 0.02 | 0.12 | 0.1 | 1 |
| Dry, nonfat solids, 1 tablespoon | 4 | 30 | 3 | Tr | 4 | 98 | 0 | Tr | 0.03 | 0.15 | 0.1 | 1 |
| Milk, goat, fluid, 1 cup | 87 | 165 | 8 | 10 | 11 | 315 | 0.2 | 390 | 0.10 | 0.26 | 0.7 | 2 |
| Cheese, 1 ounce | | | | | | | | | | | | |
| Cheddar (1 in. cube) | 37 | 115 | 7 | 9 | 0.6 | 206 | 0.3 | 400 | 0.01 | 0.12 | Tr | 0 |
| Cheddar, processed | 40 | 105 | 7 | 8 | 1 | 191 | 0.3 | 370 | Tr | 0.12 | Tr | 0 |
| Cheese foods, Cheddar | 43 | 90 | 6 | 7 | 2 | 162 | 0.2 | 300 | 0.01 | 0.16 | Tr | 0 |
| Cottage, from skim milk | 76 | 25 | 6 | Tr | 1 | 27 | 0.1 | 10 | 0.01 | 0.09 | Tr | 0 |
| Cream | 51 | 105 | 3 | 10 | 1 | 19 | 0.1 | 410 | Tr | 0.06 | Tr | 0 |
| Swiss | 39 | 105 | 8 | 8 | Tr | 262 | 0.3 | 410 | Tr | 0.11 | Tr | 0 |
| Cream, 1 tablespoon | | | | | | | | | | | | |
| Light | 72 | 30 | Tr | 3 | 1 | 15 | 0 | 120 | Tr | 0.02 | Tr | Tr |
| Heavy | 59 | 50 | Tr | 5 | Tr | 12 | 0 | 220 | Tr | 0.02 | Tr | Tr |
| Beverages, 1 cup | | | | | | | | | | | | |
| Chocolate (all milk) | 80 | 240 | 8 | 12 | 26 | 260 | 0.5 | 350 | 0.08 | 0.40 | 0.3 | 2 |
| Cocoa (all milk) | 79 | 235 | 10 | 12 | 27 | 298 | 1.0 | 400 | 0.10 | 0.46 | 0.5 | 3 |
| Chocolate flavored milk | 83 | 185 | 8 | 6 | 26 | 272 | 0.2 | 230 | 0.08 | 0.40 | 0.2 | 2 |
| Malted milk | 78 | 280 | 12 | 12 | 32 | 364 | 0.8 | 680 | 0.18 | 0.56 | | 3 |
| Desserts | | | | | | | | | | | | |
| Blanc mange, 1 cup | 76 | 275 | 9 | 10 | 39 | 290 | 0.2 | 390 | 0.08 | 0.40 | 0.2 | 2 |
| Custard, baked, 1 cup | 77 | 285 | 13 | 13 | 28 | 283 | 1.2 | 840 | 0.11 | 0.49 | 0.2 | 1 |
| Custard pudding, canned, strained (infant food), 1 ounce | 75 | 30 | 1 | 1 | 5 | 26 | 0.1 | 60 | Tr | 0.04 | Tr | Tr |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ice cream plain | | | | | | | | | | | | |
| 1/7 of quart br ck | 62 | 165 | 3 | 10 | 17 | 100 | 0 1 | 420 | 0 03 | 0 15 | 0 1 | 1 |
| 8 fluid ounces | 62 | 295 | 6 | 18 | 29 | 175 | 0 1 | 740 | 0 06 | 0,27 | 0 1 | 1 |
| *Fats, oils, related products* | | | | | | | | | | | | |
| Bacon, medium fat broiled or fried 2 slices | 13 | 95 | 4 | 9 | Tr | 4 | 0 5 | 0 | 0 08 | 0 05 | 0 8 | 0 |
| Butter, 1 tablespoon | 16 | 100 | Tr | 11 | Tr | 3 | 0 | 460† | | | | 0 |
| Fats cooking (vegetable fats) | | | | | | | | | | | | |
| 1 cup | 0 | 1770 | 0 | 200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 tablespoon | 0 | 110 | 0 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lard, 1 tablespoon | 0 | 125 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Margarine 1 tablespoon | 16 | 100 | Tr | 11 | Tr | 3 | 0 | 460§ | 0 | 0 | 0 | 0 |
| Oils, salad or cooking, 1 tablespoon | 0 | 125 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Salad dressings 1 tablespoon | | | | | | | | | | | | |
| French | 40 | 60 | Tr | 5 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Home cooked | 68 | 30 | 1 | 2 | 3 | 15 | 0 1 | 80 | 0 01 | 0 03 | Tr | Tr |
| Mayonnaise | 16 | 90 | Tr | 10 | Tr | 2 | 0 1 | 30 | Tr | Tr | 0 | 0 |
| *Eggs* | | | | | | | | | | | | |
| Eggs, raw, medium | | | | | | | | | | | | |
| 1 whole | 74 | 75 | 6 | 6 | Tr | 26 | 1 3 | 550 | 0 05 | 0 14 | Tr | 0 |
| 1 white | 88 | 15 | 3 | 0 | Tr | 2 | 0 1 | 0 | 0 | 0 08 | Tr | 0 |
| 1 yolk | 49 | 60 | 3 | 5 | Tr | 25 | 1 2 | 550 | 0 05 | 0 06 | Tr | 0 |
| Eggs, dried, whole 1 cup | 5 | 640 | 51 | 45 | 3 | 205 | 9 5 | 4040 | 0 36 | 1 14 | 0 3 | 0 |
| *Meat poultry, fish* | | | | | | | | | | | | |
| Beef, 3 ounces, without bone, cooked | | | | | | | | | | | | |
| Chuck | 51 | 265 | 22 | 19 | 0 | 9 | 2 6 | 0 | 0 04 | 0 17 | 3 5 | 0 |
| Hamburger | 47 | 315 | 19 | 26 | 0 | 8 | 2 4 | 0 | 0 07 | 0 16 | 4 1 | 0 |
| Sirloin | 54 | 255 | 20 | 19 | 0 | 9 | 2 5 | 0 | 0 06 | 0 16 | 4 1 | 0 |
| Beef canned | | | | | | | | | | | | |
| Corned beef medium fat 3 ounces | 59 | 180 | 22 | 10 | 0 | 17 | 3 7 | 0 | 0 01 | 0 20 | 2 9 | 0 |
| Corned beef hash 3 ounces | 70 | 120 | 12 | 5 | 6 | 22 | 1 1 | Tr | 0 02 | 0 11 | 2 4 | 0 |
| Strained (infant food), 1 ounce | 78 | 30 | 5 | 1 | 0 | 3 | 1 2 | 0 | Tr | 0 06 | 0 9 | 0 |
| Beef, dried 2 ounces | 48 | 115 | 19 | 4 | 0 | 11 | 2 9 | 0 | 0 04 | 0 18 | 2 2 | 0 |

* *Prepared by Bureau of Human Nutrition and Home Economics* U S D A Washington D C Based on tables in Composition of Foods—Raw, Processed Prepared Agriculture Handbook No 8 U S Dept Agriculture (See Table 144)

† Year round average

§ Based on the average vitamin A content of fortified margarine *Most margarines manufactured for use in the United States have* 15 000 I U of vitamin A added per pound [illegible]

**Table 145 Nutrients in Household Quantities of Foods (Continued)**

| Food and approximate measure or common weight | Water (Pct) | Food energy (Cal) | Protein (Gm) | Fat (Gm) | Total carbohydrate (Gm) | Calcium (Mg) | Iron (Mg) | Vitamin A Value (I U) | Thiamine (Mg) | Riboflavin (Mg) | Niacin Value (Mg) | Ascorbic acid (Mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beef and vegetable stew 1 cup | 79 | 250 | 13 | 19 | 17 | 31 | 2.6 | 2520 | 0.12 | 0.15 | 3.4 | 15 |
| Chicken, canned, boned, 3 ounces | 62 | 170 | 25 | 7 | 0 | 12 | 1.5 | 0 | 0.03 | 0.14 | 5.4 | 0 |
| Chile con carne, canned (without beans), ⅓ cup | 67 | 170 | 9 | 13 | 5 | 32 | 1.2 | 130 | 0.01 | 0.10 | 1.9 | |
| Clams, raw, meat only, 4 ounces | 80 | 90 | 15 | 2 | 4 | 109 | 7.9 | 120 | 0.11 | 0.20 | 1.8 | |
| Cod dried 1 ounce | 12 | 105 | 23 | 1 | 0 | 14 | 1.0 | 0 | 0.02 | 0.13 | 3.1 | 0 |
| Crab meat, canned or cooked, 3 ounces | 77 | 90 | 14 | 2 | 1 | 38 | 0.8 | | 0.04 | 0.05 | 2.1 | |
| Flounder, raw, 4 ounces | 83 | 80 | 17 | 1 | 0 | 69 | 0.9 | | 0.07 | 0.06 | 1.9 | |
| Haddock, fried, 1 fillet (4 by 3 by ½ inch) | 67 | 160 | 19 | 6 | 7 | 18 | 0.6 | | 0.04 | 0.09 | 2.6 | |
| Halibut, broiled, 1 steak (4 by 3 by ½ inch) | 64 | 230 | 33 | 10 | 0 | 18 | 1.0 | | 0.08 | 0.09 | 13.1 | |
| Heart, beef, raw, 3 ounces | 78 | 90 | 14 | 3 | 1 | 8 | 3.9 | 30 | 0.50 | 0.75 | 6.6 | 5 |
| Kidneys beef, raw, 3 ounces | 75 | 120 | 13 | 7 | 1 | 8 | 6.7 | 980 | 0.32 | 2.16 | 5.5 | 11 |
| Lamb, leg roast, cooked 3 ounces | 56 | 230 | 20 | 16 | 0 | 9 | 2.6 | 0 | 0.12 | 0.21 | 4.4 | 0 |
| Lamb canned, strained (infant food) 1 ounce | 79 | 30 | 4 | 1 | 0 | 5 | 0.7 | 0 | 0.01 | 0.07 | 1.1 | 0 |
| Liver, beef fried 2 ounces | 57 | 120 | 13 | 4 | 5 | 5 | 4.4 | 30330 | 0.15 | 2.25 | 8.4 | 18 |
| Liver, canned, strained (infant food), 1 ounce | 78 | 30 | 5 | 1 | Tr | 7 | 2.0 | 5440 | 0.01 | 0.61 | 1.8 | |
| Mackerel canned, solids and liquid, 3 ounces | 66 | 155 | 16 | 9 | 0 | 157 | 1.8 | 370 | 0.05 | 0.18 | 4.9 | |
| Oysters *meat only, raw, 1 cup* (13–19 medium size oysters, selects) | 80 | 200 | 24 | 5 | 13 | *226 | 13.4 | 770 | 0.35 | 0.48 | 2.8 | |
| Oyster stew, 1 cup with 6 to 8 oysters | 80 | 245 | 17 | 13 | 14 | 262 | 7.0 | 820 | 0.21 | 0.46 | 1.6 | |
| Pork loin or chops cooked 3 ounces without bone | 50 | 285 | 20 | 22 | 0 | 9 | 2.6 | 0 | 0.71 | 0.20 | 4.3 | 0 |
| Pork cured ham cooked 3 ounces without bone | 39 | 340 | 20 | 28 | Tr | 9 | 2.5 | 0 | 0.46 | 0.18 | 3.5 | 0 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pork luncheon meat, canned, spiced, 2 ounces | 55 | 165 | 8 | 14 | 1 | 5 | 1 2 | 0 | 0 18 | 0 12 | 1 6 | 0 |
| Salmon, canned, pink, 3 ounces | 70 | 120 | 17 | 5 | 0 | 159‡ | 0 7 | 60 | 0 03 | 0 16 | 6 8 | 0 |
| Sardines, canned in oil, drained solids, *3 ounces* | 57 | 180 | 22 | 9 | 1 | 328 | 2 3 | 190 | 0 01 | 0 15 | 4 1 | 0 |
| Sausage | | | | | | | | | | | | |
| Bologna, 1 piece (1 by 1½ in diam ) | 62 | 465 | 31 | 34 | 8 | 19 | 4 6 | 0 | 0 37 | 0 40 | 5 7 | 0 |
| Frankfurter, 1 cooked | 62 | 125 | 7 | 10 | 1 | 3 | 0 6 | 0 | 0 08 | 0 09 | 1 3 | 0 |
| Pork, bulk, canned, 4 ounces | 55 | 340 | 17 | 29 | 0 | 10 | 2 6 | 0 | 0 23 | 0 27 | 3 4 | 0 |
| Scallops, raw, 4 ounces | 80 | 90 | 17 | Tr | 4 | 29 | 2 0 | 0 | 0 05 | 0 11 | 1 6 | |
| Shad, raw, 4 ounces | 70 | 190 | 21 | 11 | 0 | | 0 6 | | 0 17 | 0 27 | 9 6 | |
| Shrimp, canned, meat only, 3 ounces | 66 | 110 | 23 | 1 | | 98 | 2 6 | 50 | 0 01 | 0 03 | 1 9 | 0 |
| Soups, canned, ready to-serve | | | | | | | | | | | | |
| Beef, 1 cup | 91 | 100 | 6 | 4 | 11 | 15 | 0 5 | | | | | |
| Chicken, 1 cup | 94 | 75 | 4 | 2 | 10 | 20 | 0 5 | | 0 02 | 0 12 | 1 5 | |
| Chicken, strained (infant food), 1 ounce | 87 | 15 | 1 | 1 | 2 | 11 | 0 1 | 70 | Tr | 0 03 | 0 1 | Tr |
| Clam chowder, 1 cup | 91 | 85 | 5 | 2 | 12 | 36 | 3 6 | | | | | |
| Tongue, beef, raw, 4 ounces | 68 | 235 | 19 | 17 | Tr | 10 | 3 2 | 0 | 0 14 | 0 33 | 5 7 | 0 |
| Tuna fish, drained solids, 3 ounces | 60 | 170 | 25 | 7 | 0 | 7 | 1 2 | 70 | 0 04 | 0 10 | 10 9 | 0 |
| Veal cutlet, cooked, 3 ounces without bone | 60 | 185 | 24 | 9 | 0 | 10 | 3 0 | 0 | 0 07* | 0 24* | 5 2* | 0 |
| *Mature beans and peas, nuts* | | | | | | | | | | | | |
| Almonds, shelled, unblanched, 1 cup | 5 | 850 | 26 | 77 | 28 | 361 | 6 2 | 0 | 0 35 | 0 95 | 6 5 | Tr |
| Beans, canned or cooked, 1 cup | | | | | | | | | | | | |
| Red kidney | 76 | 230 | 15 | 1 | 42 | 102 | 4 9 | 0 | 0 12 | 0 12 | 2 0 | 0 |
| Navy or other varieties with | | | | | | | | | | | | |
| Pork and *tomato sauce* | 72 | 295 | 15 | 5 | 48 | 107 | 4 7 | 220 | 0 13 | 0 09 | 1 2 | 7 |
| Pork and molasses | 70 | 325 | 15 | 8 | 50 | 146 | 5 5 | 90 | 0 13 | 0 09 | 1 2 | 7 |
| Beans, lima, dry, 1 cup | 13 | 610 | 38 | 2 | 113 | 124 | 13 7 | 0 | 0 88 | 0 32 | 3 6 | 3 |
| Brazil nuts, shelled, 1 cup | 5 | 905 | 20 | 92 | 15 | 260 | 4 8 | Tr | 1 21 | | | |
| Coconut dried shredded (sweetened), 1 cup | 3 | 345 | 2 | 24 | 33 | 27 | 2 2 | 0 | Tr | Tr | Tr | 0 |
| Cowpeas dry, 1 cup | 11 | 685 | 46 | 3 | 123 | 154 | 13 0 | 60 | 1 84 | 0 32 | 4 5 | 3 |

* Data assume cut to be prepared by braising or pot roasting Use of proportionate quantity of drippings would add approximately 50 per cent more thiamine and niacin and 25 per cent more riboflavin

‡ If bones are discarded calcium content would be much lower Bones equal about 2 per cent of total contents of can

Table 145 Nutrients in Household Quantities of Foods (Continued)

| Food and approximate measure or common weight | Water (*Pct*) | Food energy (*Cal*) | Protein (*Gm*) | Fat (*Gm*) | Total carbohydrate (*Gm*) | Calcium (*Mg*) | Iron (*Mg*) | Vitamin A Value (*I U*) | Thiamine (*Mg*) | Riboflavin (*Mg*) | Niacin Value (*Mg*) | Ascorbic acid (*Mg*) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Peanuts, roasted, shelled, 1 cup | 3 | 805 | 39 | 64 | 34 | 107 | 2.7 | 0 | 0.42 | 0.19 | 23.3 | 0 |
| Peanut butter, 1 tablespoon | 2 | 90 | 4 | 8 | 3 | 12 | 0.3 | 0 | 0.02 | 0.02 | 2.6 | 0 |
| Peas, split, dry, 1 cup | 10 | 690 | 49 | 2 | 123 | 66 | 10.2 | 740 | 1.53 | 0.56 | 6.3 | 4 |
| Pecans, 1 cup halves | 3 | 750 | 10 | 79 | 14 | 80 | 2.6 | 50 | 0.77 | 0.12 | 1.0 | 2 |
| Soybeans, dry, 1 cup | 7 | 695 | 73 | 38 | 73 | 477 | 16.8 | 230 | 2.25 | 0.65 | 4.9 | Tr |
| Walnuts, English, 1 cup halves | 3 | 655 | 15 | 64 | 16 | 83 | 2.1 | 30 | 0.48 | 0.13 | 1.2 | 3 |
| *Vegetables* | | | | | | | | | | | | |
| Asparagus | | | | | | | | | | | | |
| Cooked, 1 cup cut spears | 92 | 35 | 4 | Tr | 6 | 33 | 1.8 | 1820 | 0.23 | 0.30 | 2.1 | 40 |
| Canned green, 6 spears, medium size | 92 | 20 | 2 | Tr | 3 | 18 | 1.8 | 770 | 0.06 | 0.08 | 0.9 | 17 |
| Canned bleached, 6 spears, medium size | 92 | 20 | 2 | Tr | 3 | 15 | 1.0 | 70 | 0.05 | 0.07 | 0.8 | 17 |
| Beans, lima, immature, cooked 1 cup | 75 | 150 | 8 | 1 | 29 | 46 | 2.7 | 460 | 0.22 | 0.14 | 1.8 | 24 |
| Beans, snap, green, cooked, 1 cup | 92 | 25 | 2 | Tr | 6 | 45 | 0.9 | 830 | 0.09 | 0.12 | 0.6 | 18 |
| Beets, cooked, diced, 1 cup | 88 | 70 | 2 | Tr | 16 | 35 | 1.2 | 30 | 0.03 | 0.07 | 0.5 | 11 |
| Broccoli, cooked, flower stalks, 1 cup | 90 | 45 | 5 | Tr | 8 | 195 | 2.0 | 5100 | 0.10 | 0.22 | 1.2 | 111 |
| Brussels sprouts, cooked, 1 cup | 85 | 60 | 6 | 1 | 12 | 44 | 1.7 | 520 | 0.05 | 0.16 | 0.6 | 61 |
| Cabbage, 1 cup | | | | | | | | | | | | |
| Raw, shredded | 92 | 25 | 1 | Tr | 5 | 46 | 0.5 | 80 | 0.06 | 0.05 | 0.3 | 50 |
| Cooked | 92 | 40 | 2 | Tr | 9 | 78 | 0.8 | 150 | 0.08 | 0.08 | 0.5 | 53 |
| Carrots | | | | | | | | | | | | |
| Raw, grated, 1 cup | 88 | 45 | 1 | Tr | 10 | 43 | 0.9 | 13200 | 0.06 | 0.06 | 0.7 | 7 |
| Cooked, diced, 1 cup | 91 | 45 | 1 | 1 | 9 | 38 | 0.9 | 18130 | 0.07 | 0.07 | 0.7 | 6 |
| Canned, strained (infant food), 1 ounce | 92 | 10 | Tr | 0 | 2 | 7 | 0.2 | 2530 | 0.01 | 0.01 | 0.1 | 1 |
| Cauliflower, cooked, flower buds, 1 cup | 92 | 30 | 3 | Tr | 6 | 26 | 1.3 | 110 | 0.07 | 0.10 | 0.6 | 34 |
| Celery, 1 cup | | | | | | | | | | | | |
| Raw, diced | 94 | 20 | 1 | Tr | 4 | 50 | 0.5 | 0 | 0.05 | 0.04 | 0.4 | 7 |
| Cooked, diced | 94 | 25 | 2 | Tr | 5 | 65 | 0.6 | 0 | 0.05 | 0.04 | 0.4 | 6 |
| Collards cooked 1 cup | 87 | 75 | 7 | 1 | 14 | 473 | 3.0 | 14500 | 0.15 | 0.46 | 3.2 | 84 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Corn, sweet | | | | | | | | | | | | |
| Cooked, 1 ear (5 in long) | 75 | 85 | 3 | 1 | 20 | 5 | 0.6 | 390† | 0.11 | 0.10 | 1.4 | 8 |
| Canned, solids and liquid, 1 cup | 80 | 170 | 5 | 1 | 41 | 10 | 1.3 | 520† | 0.07 | 0.13 | 2.4 | 14 |
| Cowpeas, immature seed, cooked, 1 cup | 75 | 150 | 11 | 1 | 25 | 59 | 4.0 | 620 | 0.46 | 0.13 | 1.3 | 32 |
| Cucumbers, raw, 6 slices (⅛ in thick, center section) | 96 | 5 | Tr | 0 | 1 | 5 | 0.2‡ | 0‡ | 0.02 | 0.02 | 0.1 | 4 |
| Dandelion greens, cooked, 1 cup | 86 | 80 | 5 | 1 | 16 | 337 | 5.6 | 27310 | 0.23 | 0.22 | 1.3 | 29 |
| Endive, raw, 1 pound | 93 | 90 | 7 | 1 | 18 | 359 | 7.7 | 13600 | 0.30 | 0.53 | 1.8 | 49 |
| Kale, cooked, 1 cup | 87 | 45 | 4 | 1 | 8 | 248 | 2.4 | 9220 | 0.08 | 0.25 | 1.9 | 56 |
| Lettuce, headed, raw, 2 large or 4 small leaves | 95 | 5 | 1 | Tr | 1 | 11 | 0.2 | 270 | 0.02 | 0.04 | 0.1 | 4 |
| Mushrooms, canned, solids and liquid, 1 cup | 93 | 30 | 3 | Tr | 9 | 17 | 2.0 | 0 | 0.04 | 0.60 | 4.8 | |
| Mustard greens, cooked, 1 cup | 92 | 30 | 3 | Tr | 6 | 308 | 4.1 | 10050 | 0.08 | 0.25 | 1.0 | 63 |
| Okra, cooked, 8 pods (3 in long, ⅝ in diam) | 90 | 30 | 2 | Tr | 6 | 70 | 0.6 | 630 | 0.05 | 0.05 | 0.7 | 17 |
| Onions, raw | | | | | | | | | | | | |
| Mature, 1 onion (2½ in diam) | 88 | 50 | 2 | Tr | 11 | 35 | 0.6 | 60 | 0.04 | 0.04 | 0.2 | 10 |
| Young green, 6 small onions without tops | 88 | 25 | Tr | Tr | 5 | 68 | 0.4 | 30 | 0.02 | 0.02 | 0.1 | 12 |
| Parsnips, cooked, 1 cup | 84 | 95 | 2 | 1 | 22 | 88 | 1.1 | 0 | 0.09 | 0.16 | 0.3 | 19 |
| Peas, green | | | | | | | | | | | | |
| Cooked, 1 cup | 82 | 110 | 8 | 1 | 19 | 35 | 3.0 | 1150 | 0.40 | 0.22 | 3.7 | 24 |
| Canned, strained (infant food), 1 ounce | 87 | 15 | 1 | Tr | 2 | 5 | 0.4 | 180 | 0.03 | 0.02 | 0.3 | 2 |
| Peppers, green, raw, 1 medium | 92 | 15 | 1 | Tr | 4 | 7 | 0.3 | 400 | 0.02 | 0.04 | 0.2 | 77 |
| Potatoes | | | | | | | | | | | | |
| Baked, 1 medium (2½ in diam) | 74 | 95 | 2 | Tr | 22 | 13 | 0.8 | 20 | 0.11 | 0.05 | 1.4 | 17 |
| Boiled in skin, 1 medium (2½ in diam) | 78 | 120 | 3 | Tr | 27 | 16 | 1.0 | 30 | 0.14 | 0.06 | 1.6 | 22 |
| Boiled after peeling, 1 medium (2½ in diam) | 78 | 105 | 3 | Tr | 24 | 14 | 0.9 | 20 | 0.12 | 0.04 | 1.3 | 17 |
| French fried, 8 pieces (2 by ½ by ½ in) | 20 | 155 | 2 | 8 | 21 | 12 | 0.8 | 20 | 0.07 | 0.04 | 1.3 | 11 |
| Potato chips 10 medium (2 in diam) | 3 | 110 | 1 | 7 | 10 | 6 | 0.4 | 10 | 0.04 | 0.02 | 0.6 | 2 |

† Vitamin A based on yellow corn, white corn contains only a trace.

‡ Based on pared cucumber, unpared contains about 0.6 mg of iron and 130 I.U. of vitamin A

**Table 145. Nutrients in Household Quantities of Foods (Continued)**

| Food and approximate measure or common weight | Water (*Pct*) | Food energy (*Cal*) | Protein (*Gm*) | Fat (*Gm*) | Total carbohydrate (*Gm*) | Calcium (*Mg*) | Iron (*Mg*) | Vitamin A Value (*I U*) | Thiamine (*Mg*) | Riboflavin (*Mg*) | Niacin Value (*Mg*) | Ascorbic acid (*Mg*) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pumpkin, canned, 1 cup | 90 | 75 | 2 | 1 | 18 | 46 | 1.6 | 7750 | 0.04 | 0.14 | 1.2 | |
| Radishes, raw, 4 small | 94 | 5 | Tr | 0 | 1 | 7 | 0.2 | 10 | 0.01 | Tr | 0.1 | 5 |
| Rutabagas, cooked, cubed or sliced, 1 cup | 91 | 50 | 1 | Tr | 12 | 85 | 0.6 | 540 | 0.08 | 0.11 | 1.1 | 33 |
| Sauerkraut, canned, drained solids, 1 cup | 91 | 30 | 2 | Tr | 7 | 54 | 0.8 | 60 | 0.05 | 0.10 | 0.2 | 24 |
| Soybean sprouts, raw, 1 cup | 86 | 50 | 7 | 1 | 6 | 51 | 1.1 | 190 | 0.24 | 0.21 | 0.9 | 14 |
| Spinach | | | | | | | | | | | | |
| Cooked, 1 cup | 91 | 45 | 6 | 1 | 6 | 223* | 3.6 | 21200 | 0.14 | 0.36 | 1.1 | 54 |
| Canned, strained (infant food), 1 ounce | 94 | 5 | 1 | Tr | 1 | 22* | 0.4 | 1190 | 0.01 | 0.03 | 0.1 | 2 |
| Squash | | | | | | | | | | | | |
| Summer, cooked, diced, 1 cup | 95 | 35 | 1 | Tr | 8 | 32 | 0.8 | 550 | 0.08 | 0.15 | 1.3 | 23 |
| Winter, baked, *mashed*, 1 cup | 86 | 95 | 4 | 1 | 23 | 49 | 1.6 | 12690 | 0.10 | 0.31 | 1.2 | 14 |
| Winter, canned, strained (infant food), 1 ounce | 91 | 10 | Tr | Tr | 2 | 9 | 0.1 | 560 | 0.01 | 0.02 | 0.1 | 1 |
| Sweet potatoes, peeled, 1 sweet potato | | | | | | | | | | | | |
| Baked (5 by 2 in ) | 61 | 185 | 3 | 1 | 41 | 44 | 1.1 | 11410† | 0.12 | 0.08 | 0.9 | 28 |
| Boiled (5 by 2½ in ) | 69 | 250 | 4 | 1 | 57 | 62 | 1.4 | 15780† | 0.18 | 0.11 | 1.3 | 41 |
| Tomatoes | | | | | | | | | | | | |
| Raw, 1 medium (2 by 2½ in ) | 94 | 30 | 2 | Tr | 6 | 16 | 0.9 | 1640 | 0.08 | 0.06 | 0.8 | 35 |
| Canned or cooked, 1 cup | 94 | 45 | 2 | Tr | 9 | 27 | 1.5 | 2540 | 0.14 | 0.08 | 1.7 | 40 |
| Tomato juice, canned, 1 cup | 94 | 50 | 2 | Tr | 10 | 17 | 1.0 | 2540 | 0.12 | 0.07 | 1.8 | 38 |
| Turnips, cooked, diced, 1 cup | 92 | 40 | 1 | Tr | 9 | 62 | 0.8 | Tr | 0.06 | 0.09 | 0.6 | 28 |
| Turnip greens, cooked, 1 cup | 90 | 45 | 4 | 1 | 8 | 376 | 3.5 | 15370 | 0.09 | 0.59 | 1.0 | 87 |
| Vegetables, mixed canned, strained (infant food), 1 ounce | 90 | 10 | Tr | 0 | 2 | 9 | 0.3 | ‡ | 0.01 | 0.01 | 0.1 | 1 |
| *Fruits* | | | | | | | | | | | | |
| Apples, raw, 1 medium (2½ in diam ) | 84 | 75 | Tr | 1 | 20 | 8 | 0.4 | 120 | 0.05 | 0.04 | 0.2 | 6 |
| Apple juice, fresh or canned, 1 cup | 86 | 125 | Tr | 0 | 34 | 15 | 1.2 | 90 | 0.05 | 0.07 | Tr | 2 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Apple betty, 1 cup | 64 | 345 | 4 | 7 | 70 | 34 | 0.2 | 370 | 0.13 | 0.09 | 1.1 | 3 |
| Applesauce, canned sweetened, 1 cup | 80 | 185 | 1 | Tr | 50 | 10 | 1.0 | 80 | 0.05 | 0.03 | 0.1 | 3 |
| Apricots | | | | | | | | | | | | |
| Raw, 3 apricots | 85 | 55 | 1 | Tr | 14 | 17 | 0.5 | 2990 | 0.03 | 0.05 | 0.9 | 7 |
| Canned in sirup, 4 medium halves and 2 tablespoons sirup | 77 | 95 | 1 | Tr | 26 | 12 | 0.4 | 1650 | 0.02 | 0.03 | 0.4 | 5 |
| Canned, strained (infant food), 1 ounce | 83 | 15 | Tr | Tr | 4 | 6 | 0.3 | 480 | 0.01 | 0.01 | 0.1 | 1 |
| Dried, cooked, unsweetened, fruit and liquid, 1 cup | 75 | 240 | 5 | Tr | 62 | 80 | 4.6 | 6900 | 0.01 | 0.14 | 2.8 | 9 |
| Avocados, raw, ½ peeled fruit (3½ by 3¼ in.) | 65 | 280 | 2 | 30 | 6 | 11 | 0.7 | 330 | 0.07 | 0.15 | 1.3 | 18 |
| Bananas, raw, 1 medium (6 by 1½ in.) | 75 | 90 | 1 | Tr | 23 | 8 | 0.6 | 430 | 0.04 | 0.05 | 0.7 | 10 |
| Blackberries, raw, 1 cup | 85 | 80 | 2 | 1 | 18 | 46 | 1.3 | 280 | 0.05 | 0.06 | 0.5 | 30 |
| Blueberries, raw, 1 cup | 83 | 85 | 1 | 1 | 21 | 22 | 1.1 | 400 | 0.04 | 0.03 | 0.4 | 23 |
| Cantaloups, raw, ½ melon (5 in. diam.) | 94 | 35 | 1 | Tr | 8 | 31 | 0.7 | 6190§ | 0.09 | 0.07 | 0.9 | 59 |
| Cherries, 1 cup pitted | | | | | | | | | | | | |
| Raw | 83 | 65 | 1 | 1 | 16 | 19 | 0.4 | 710 | 0.05 | 0.06 | 0.4 | 9 |
| Canned red sour | 87 | 120 | 2 | 1 | 30 | 28 | 0.8 | 1840 | 0.07 | 0.04 | 0.4 | 14 |
| Cranberry sauce, sweetened, 1 cup | 48 | 550 | Tr | 1 | 142 | 22 | 0.8 | 80 | 0.06 | 0.06 | 0.3 | 5 |
| Dates, "fresh" and dried, pitted and cut, 1 cup | 20 | 505 | 4 | 1 | 134 | 128 | 3.7 | 100 | 0.16 | 0.17 | 3.9 | 0 |
| Figs, raw, 3 small (1½ in. diam.) | 78 | 90 | 2 | Tr | 22 | 62 | 0.7 | 90 | 0.06 | 0.06 | 0.6 | 2 |
| Figs, dried 1 large (2 by 1 in.) | 24 | 55 | 1 | Tr | 14 | 39 | 0.6 | 20 | 0.03 | 0.02 | 0.4 | 0 |
| Fruit cocktail, canned, solids and liquid, 1 cup | 81 | 180 | 1 | 1 | 48 | 23 | 1.0 | 410 | 0.03 | 0.03 | 0.9 | 5 |
| Grapefruit, raw, 1 cup sections | 89 | 75 | 1 | Tr | 20 | 43 | 0.4 | 20 | 0.07 | 0.04 | 0.4 | 78 |
| Grapefruit juice | | | | | | | | | | | | |
| Canned, unsweetened, 1 cup | 89 | 90 | 1 | Tr | 24 | 20 | 0.7 | 20 | 0.07 | 0.04 | 0.4 | 85 |
| Frozen concentrate, 6 ounce can | 58 | 295 | 4 | 1 | 77 | 63 | 2.4 | 60 | 0.24 | 0.13 | 1.4 | 272 |
| Grapes, 1 cup | | | | | | | | | | | | |
| American type (slip skin) | 82 | 85 | 2 | 2 | 18 | 20 | 0.7 | 90 | 0.07 | 0.05 | 0.3 | 5 |
| European type (adherent skin) | 82 | 100 | 1 | 1 | 26 | 26 | 0.9 | 120 | 0.09 | 0.06 | 0.4 | 6 |

* Calcium may not be usable because of presence of oxalic acid

† If very pale varieties only were used, the vitamin A value would be much lower

‡ Vitamin A value ranges from 270 to 1510 I.U. per ounce

§ Vitamin A based on deeply colored yellow varieties

Table 145 Nutrients in Household Quantities of Foods (Continued)

| Food and approximate measure or common weight | Water (Pct) | Food energy (Cal) | Protein (Gm) | Fat (Gm) | Total carbohydrate (Gm) | Calcium (Mg) | Iron (Mg) | Vitamin A Value (I U) | Thiamine (Mg) | Riboflavin (Mg) | Niacin Value (Mg) | Ascorbic acid (Mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Grape juice, bottled, 1 cup | 81 | 170 | 1 | 0 | 46 | 25 | 0.8 | | 0.09 | 0.12 | 0.6 | Tr |
| Lemon juice, fresh, 1 cup | 91 | 60 | 1 | Tr | 19 | 34 | 0.2 | 0 | 0.11 | 0.01 | 0.3 | 122 |
| Lime juice, fresh, 1 cup | 91 | 60 | 1 | 0 | 20 | 34 | 0.2 | 0 | 0.11 | 0.01 | 0.3 | 65 |
| Oranges, 1 medium (3 in diam) | 87 | 70 | 1 | Tr | 17 | 51 | 0.6 | 290 | 0.12 | 0.04 | 0.4 | 77 |
| Orange juice | | | | | | | | | | | | |
| Fresh, 1 cup | 88 | 110 | 2 | Tr | 27 | 47 | 0.5 | 460 | 0.19 | 0.06 | 0.6 | 122 |
| Canned, unsweetened, 1 cup | 88 | 110 | 2 | Tr | 27 | 25 | 0.7 | 240 | 0.17 | 0.04 | 0.6 | 103 |
| Frozen concentrate, 6 ounce can | 58 | 300 | 5 | 1 | 75 | 69 | 2.0 | 670 | 0.48 | 0.11 | 1.5 | 285 |
| Papayas raw, cubed, 1 cup | 89 | 70 | 1 | Tr | 18 | 36 | 0.5 | 3190 | 0.06 | 0.07 | 0.5 | 102 |
| Peaches | | | | | | | | | | | | |
| Raw, 1 medium (2½ by 2 in diam) | 87 | 45 | 1 | Tr | 12 | 8 | 0.6 | 880 | 0.02 | 0.05 | 0.9 | 8 |
| Canned in sirup, solids and liquid, 1 cup | 81 | 175 | 1 | Tr | 47 | 13 | 1.0 | 1160 | 0.02 | 0.05 | 1.8 | 11 |
| Canned, strained (infant food), 1 ounce | 83 | 15 | Tr | Tr | 4 | 2 | 0.3 | 180 | 0.01 | 0.01 | 0.2 | 1 |
| Dried, cooked, unsweetened, 1 cup (10–12 halves and 6 tablespoons liquid) | 76 | 225 | 2 | 1 | 59 | 38 | 5.9 | 2750 | 0.01 | 0.16 | 4.3 | 11 |
| Pears | | | | | | | | | | | | |
| Raw, 1 pear (3 by 2½ in diam) | 83 | 95 | 1 | 1 | 24 | 20 | 0.5 | 30 | 0.03 | 0.06 | 0.2 | 6 |
| Canned in sirup, 2 medium size halves and 2 tablespoons sirup | 81 | 80 | Tr | Tr | 22 | 9 | 0.2 | Tr | 0.01 | 0.02 | 0.2 | 2 |
| Canned, strained (infant food), 1 ounce | 86 | 15 | Tr | Tr | 4 | 3 | 0.1 | 10 | Tr | 0.01 | 0.1 | Tr |
| Persimmons, Japanese raw, seedless kind, 1 persimmon (2¼ in diam) | 78 | 95 | 1 | Tr | 24 | 7 | 0.4 | 3270 | 0.06 | 0.05 | Tr | 13 |
| Pineapple | | | | | | | | | | | | |
| Raw, diced, 1 cup | 85 | 75 | 1 | Tr | 19 | 22 | 0.4 | 180 | 0.12 | 0.04 | 0.3 | 33 |
| Canned in sirup, 2 small or 1 large slice and 2 tablespoons juice | 78 | 95 | Tr | Tr | 26 | 35 | 0.7 | 100 | 0.09 | 0.02 | 0.2 | 11 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pineapple juice canned, *1 cup* | 86 | 120 | 1 | Tr | 32 | 37 | 1 2 | 200 | 0 13 | 0 04 | 0 4 | 22 |
| Plums, raw, 1 plum (2 in diam ) | 86 | 30 | Tr | Tr | 7 | 10 | 0 3 | 200 | 0 04 | 0 02 | 0 3 | 3 |
| Prunes, cooked, unsweetened, 1 cup (16–18 prunes and ⅓ cup liquid) | 65 | 310 | 3 | 1 | 82 | 62 | 4 5 | 2210 | 0 07 | 0 20 | 2 0 | 2 |
| Prune juice, canned, 1 cup | 80 | 170 | 1 | 0 | 46 | 60 | 4 3 | | 0 07 | 0 19 | 1 0 | 2 |
| Raisins, dried, 1 cup | 24 | 430 | 4 | 1 | 114 | 125 | 5 3 | 80 | 0 24 | 0 13 | 0 8 | Tr |
| Raspberries, red, raw, 1 cup | 84 | 70 | 1 | Tr | 17 | 49 | 1 1 | 160 | 0 03 | 0 08 | 0 4 | 29 |
| Rhubarb, cooked with sugar, 1 cup | 63 | 385 | 1 | Tr | 98 | 112† | 1 1 | 70 | 0 02 | | 0 2 | 17 |
| Strawberries | | | | | | | | | | | | |
| Raw, 1 cup | 90 | 55 | 1 | 1 | 12 | 42 | 1 2 | 90 | 0 04 | 0 10 | 0 4 | 89 |
| Frozen, 3 ounces | 72 | 90 | 1 | Tr | 23 | 19 | 0 5 | 30 | 0 02 | 0 04 | 0 2 | 35 |
| Tangerines, 1 medium (2½ in diam ) | 87 | 35 | 1 | Tr | 9 | 27 | 0 3 | 340 | 0 06 | 0 02 | 0 2 | 25 |
| Tangerine juice, canned, 1 cup | 89 | 95 | 2 | 1 | 23 | 47 | 0 5 | 1040 | 0 15 | 0 06 | 0 6 | 64 |
| Watermelons, ½ slice (¾ by 10 in ) | 92 | 45 | 1 | Tr | 11 | 11 | 0 3 | 950 | 0 08 | 0 08 | 0 3 | 10 |
| *Grain products* | | | | | | | | | | | | |
| Barley, pearled, light, dry, 1 cup | 11 | 710 | 17 | 2 | 160 | 32 | 4 1 | 0 | 0 25 | 0 17 | 6 3 | 0 |
| Biscuits, baking powder, enriched flour, 1 biscuit (2½ in diam ) | 27 | 130 | 3 | 4 | 20 | 83 | 0 7 | 0 | 0 09 | 0 08 | 0 7 | 0 |
| Bran flakes, 1 cup | 4 | 115 | 4 | 1 | 32 | 24 | 2 0 | 0 | 0 19 | 0 09 | 3 5 | 0 |
| Breads, 1 slice | | | | | | | | | | | | |
| Boston brown unenriched | 44 | 105 | 2 | 1 | 22 | 89 | 1 2 | 70 | 0 04 | 0 06 | 0 7 | 0 |
| Rye | 35 | 55 | 2 | Tr | 12 | 17 | 0 4 | 0 | 0 04 | 0 02 | 0 4 | 0 |
| White, unenriched, 4 per cent nonfat milk solids* | 35 | 65 | 2 | 1 | 12 | 18 | 0 1 | 0 | 0 01 | 0 02 | 0 2 | 0 |
| White, enriched, 4 per cent nonfat milk solids* | 35 | 65 | 2 | 1 | 12 | 18 | 0 4‡ | 0 | 0 06‡ | 0 04‡ | 0 5‡ | 0 |
| White, *enriched, 6 per cent nonfat* milk solids | 34 | 65 | 2 | 1 | 12 | 21 | 0 4‡ | 0 | 0 06‡ | 0 04‡ | 0 5‡ | 0 |
| Whole wheat | 37 | 55 | 2 | 1 | 11 | 22 | 0 5 | 0 | 0 07 | 0 03 | 0 7 | 0 |
| Cakes | | | | | | | | | | | | |
| Angel food, 2 inch sector (1/12 of cake, 8 in diam ) | 32 | 110 | 3 | Tr | 23 | 2 | 0 1 | 0 | Tr | 0 05 | 0 1 | 0 |
| Doughnuts cake type, 1 doughnut | 19 | 135 | 2 | 7 | 17 | 23 | 0 2 | 40 | 0 05 | 0 04 | 0 4 | 0 |

† Calcium may not be usable because of presence of oxalic acid

* When the amount of nonfat milk solids in commercial bread is unknown use bread with 4 per cent nonfat milk solids

‡ *Iron thiamine* riboflavin and niacin are based on the minimum levels of enrichment specified in the standards of identity of breads proposed by ıe Federal Security Agency and published in the Federal Register August 3 1913

**Table 145 *Nutrients in Household Quantities of Foods* (Continued)**

| Food and approximate measure or common weight | Water (*Pct*) | Food energy (*Cal*) | Protein (*Gm*) | Fat (*Gm*) | Total carbohydrate (*Gm*) | Calcium (*Mg*) | Iron (*Mg*) | Vitamin A Value (*IU*) | Thiamine (*Mg*) | Riboflavin (*Mg*) | Niacin Value (*Mg*) | Ascorbic acid (*Mg*) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cakes (Continued) | | | | | | | | | | | | |
| Foundation, 1 square (3 by 2 by 1¾ inch) | 25 | 230 | 4 | 8 | 36 | 82 | 0.3 | 100‡ | 0.02 | 0.05 | 0.2 | 0 |
| Foundation, plain icing, 2 inch sector, layer cake (1/16 of cake, 10 in diam) | 24 | 410 | 6 | 11 | 72 | 121 | 0.5 | 150‡ | 0.03 | 0.08 | 0.2 | 0 |
| Fruit cake, dark, 1 piece (2 by 2 by ½ inch) | 23 | 105 | 2 | 4 | 17 | 29 | 0.8 | 50§ | 0.04 | 0.04 | 0.3 | 0 |
| Gingerbread, 1 piece (2 by 2 by 2 in) | 30 | 180 | 2 | 7 | 28 | 63 | 1.4 | 50 | 0.02 | 0.05 | 0.6 | 0 |
| Plain cake and cupcakes, 1 cupcake (2¾ in diam) | 27 | 130 | 3 | 3 | 23 | 62 | 0.2 | 50/ | 0.01 | 0.03 | 0.1 | 0 |
| Sponge, 2 inch sector (1/12 of cake, 8 in diam) | 32 | 115 | 3 | 2 | 22 | 11 | 0.6 | 210 | 0.02 | 0.06 | 0.1 | 0 |
| Cereal foods, dry, precooked (infant food), 1 ounce | 6 | 105 | 4 | 1 | 21 | 185 | 9.6 | 0 | 0.34 | 0.13 | 1.4° | 0 |
| Cookies, plain and assorted, 1 3 inch cooky | 5 | 110 | 2 | 3 | 19 | 6 | 0.2 | 0 | 0.01 | 0.01 | 0.1 | 0 |
| Corn bread or muffins made with enriched, degermed corn meal, 1 muffin (2¾ in diam) | 49 | 105 | 3 | 2 | 18 | 67 | 0.9 | 60Δ | 0.08 | 0.11 | 0.6 | 0 |
| Corn flakes, 1 cup | 4 | 95 | 2 | Tr | 21 | 3 | 0.3 | 0 | 0.01 | 0.02 | 0.4 | 0 |
| Corn grits, degermed, cooked, 1 cup | | | | | | | | | | | | |
| Unenriched | 87 | 120 | 3 | Tr | 27 | 2 | 0.2 | 100□ | 0.04 | 0.01 | 0.4 | 0 |
| Enriched | 87 | 120 | 3 | Tr | 27 | 2 | 0.7 | 100□ | 0.11 | 0.08 | 1.0 | 0 |
| Crackers | | | | | | | | | | | | |
| Graham, 4 small or 2 medium | 6 | 55 | 1 | 1 | 10 | 3 | 0.3 | 0 | 0.04 | 0.02 | 0.2 | 0 |
| Soda, plain, 2 crackers (2½ in diam) | 6 | 45 | 1 | 1 | 8 | 2 | 0.1 | 0 | 0.01 | 0.01 | 0.1 | 0 |
| Farina enriched, cooked, 1 cup | 89 | 105 | 3 | Tr | 22 | 7 | 0.5 | 0 | 0.10 | 0.07 | 0.4 | 0 |
| Macaroni, cooked, 1 cup | | | | | | | | | | | | |
| Unenriched | 61 | 210 | 7 | 1 | 42 | 13 | 0.8 | 0 | 0.03 | 0.02 | 0.7 | 0 |
| Enriched | 61 | 210 | 7 | 1 | 42 | 13 | 1.5 | 0 | 0.24 | 0.15 | 2.0 | 0 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Muffins made with enriched flour, 1 muffin ($2\frac{3}{4}$ in diam) | 37 | 135 | 4 | 4 | 20 | 99 | 0.8 | 50 | 0.09 | 0.10 | 0.7 | 0 |
| *Noodles, containing egg unenriched, cooked, 1 cup* | 84 | 105 | 4 | 1 | 20 | 6 | 0.6 | 60 | 0.05 | 0.03 | 0.6 | 0 |
| Oatmeal or rolled oats | | | | | | | | | | | | |
| Cooked, 1 cup | 85 | 150 | 5 | 3 | 26 | 21 | 1.7 | 0 | 0.22 | 0.05 | 0.4 | 0 |
| Precooked (infant food), dry, 1 ounce | 7 | 105 | 4 | 1 | 19 | 225 | 8.9 | 0 | 0.36 | 0.10 | 0.7* | 0 |
| Pancakes, baked, wheat, with enriched flour, 1 cake (4 in diam) | 55 | 60 | 2 | 2 | 7 | 43 | 0.4 | 50 | 0.05 | 0.06 | 0.3 | Tr |
| *Pies, 4-inch sector* (9 in diam) | | | | | | | | | | | | |
| Apple | 48 | 330 | 3 | 13 | 53 | 9 | 0.5 | 220 | 0.04 | 0.02 | 0.3 | 1 |
| Custard | 59 | 265 | 7 | 11 | 34 | 162 | 1.6 | 290 | 0.07 | 0.21 | 0.4 | 0 |
| Lemon meringue | 47 | 300 | 4 | 12 | 45 | 24 | 0.6 | 210 | 0.04 | 0.10 | 0.2 | 1 |
| Mince | 43 | 340 | 3 | 9 | 62 | 22 | 3.0 | 10 | 0.09 | 0.05 | 0.5 | 1 |
| Pumpkin | 59 | 265 | 5 | 12 | 34 | 70 | 1.0 | 2480 | 0.04 | 0.15 | 0.4 | 0 |
| Pretzels, 5 small sticks | 8 | 20 | Tr | Tr | 4 | 1 | 0 | 0 | Tr | Tr | Tr | 0 |
| Rice, cooked 1 cup | | | | | | | | | | | | |
| Converted | 72 | 205 | 4 | Tr | 45 | 14 | 0.5 | 0 | 0.10 | 0.02 | 1.9 | 0 |
| White or milled | 71 | 200 | 4 | Tr | 44 | 13 | 0.5 | 0 | 0.02 | 0.01 | 0.7 | 0 |
| Rice, puffed, 1 cup | 4 | 55 | 1 | Tr | 12 | 3 | 0.3 | 0 | 0.01 | 0.01 | 0.1 | 0 |
| Rolls, plain, enriched, 1 roll (12 per pound) | 29 | 120 | 3 | 2 | 21 | 21 | 0.7† | 0 | 0.09† | 0.06† | 0.8† | 0 |
| Spaghetti, unenriched cooked 1 cup | 61 | 220 | 7 | 1 | 44 | 13 | 0.9 | 0 | 0.03 | 0.02 | 0.7 | 0 |
| Waffles, baked, with enriched flour, 1 waffle ($4\frac{1}{2}$ by $5\frac{5}{8}$ by $\frac{1}{2}$ in) | 40 | 215 | 7 | 8 | 28 | 144 | 1.4 | 270 | 0.14 | 0.20 | 1.0 | 0 |
| Wheat flours | | | | | | | | | | | | |
| Whole, 1 cup stirred | 12 | 400 | 16 | 2 | 85 | 49 | 4.0 | 0 | 0.66 | 0.14 | 5.2 | 0 |

‡ If fat used is butter or fortified margarine the vitamin A value would be 330 I U per square and 520 I U per 2 inch sector, iced

§ If fat used is butter or fortified margarine the vitamin A value would be 120 I U

/ If fat used is butter or fortified margarine the vitamin A value would be 150 I U per cupcake

ϴ Based on products ranging from 0.7 to 1.9 mg per ounce The niacin value of some products is as high as 6.5 mg

△ Based on recipe using white corn meal if yellow corn meal is used vitamin A value is 120 I U

○ Vitamin A based on yellow corn grits white corn grits contain only a trace

* Based on products ranging from 0.4 to 1.2 mg per ounce of cereal *The niacin value of some products is as high as 6.5 mg per ounce*

† Iron thiamine riboflavin and niacin are based on the minimum levels of enrichment specified in the standards of identity of breads proposed by *the Federal Security Agency* and published in the Federal Register August 3 1913

**Table 145 Nutrients in Household Quantities of Foods (Continued)**

| Food and approximate measure or common weight | Water (*Pct*) | Food energy (*Cal*) | Protein (*Gm*) | Fat (*Gm*) | Total carbohydrate (*Gm*) | Calcium (*Mg*) | Iron (*Mg*) | Vitamin A Value (*IU*) | Thiamine (*Mg*) | Riboflavin (*Mg*) | Niacin Value (*Mg*) | Ascorbic acid (*Mg*) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wheat flours (Continued) | | | | | | | | | | | | |
| All purpose or family flour | | | | | | | | | | | | |
| Unenriched, 1 cup sifted | 12 | 400 | 12 | 1 | 84 | 18 | 0.9 | 0 | 0.07 | 0.05 | 1.0 | 0 |
| Enriched, 1 cup sifted | 12 | 400 | 12 | 1 | 84 | 18 | 3.2‡ | 0 | 0.48‡ | 0.29‡ | 3.8‡ | 0 |
| Wheat germ, 1 cup stirred | 11 | 245 | 17 | 7 | 34 | 57 | 5.5 | 0 | 1.39 | 0.54 | 3.1 | 0 |
| Wheat, shredded, 1 large biscuit, 1 ounce | 6 | 100 | 3 | 1 | 23 | 13 | 1.0 | 0 | 0.06 | 0.03 | 1.3 | 0 |
| *Sugars, sweets* | | | | | | | | | | | | |
| Candy, 1 ounce | | | | | | | | | | | | |
| Caramels | 7 | 120 | 1 | 3 | 22 | 36 | 0.7 | 50 | 0.01 | 0.04 | Tr | Tr |
| Chocolate, sweetened, milk | 1 | 145 | 2 | 9 | 16 | 61 | 0.3 | 40 | 0.03 | 0.11 | 0.2 | 0 |
| Fudge, plain | 5 | 115 | Tr | 3 | 23 | 14§ | 0.1 | 60 | Tr | 0.02 | Tr | Tr |
| Hard | 1 | 110 | 0 | 0 | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Marshmallows | 15 | 90 | 1 | 0 | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chocolate sirup 1 tablespoon | 39 | 40 | Tr | Tr | 11 | 3/ | 0.3 | | | | | |
| Honey, strained or extracted, 1 tablespoon | 20 | 60 | Tr | 0 | 17 | 1 | 0.2 | 0 | Tr | 0.01 | Tr | 1 |
| Jams, marmalades, preserves, 1 tablespoon | 28 | 55 | Tr | Tr | 14 | 2 | 0.1 | Tr | Tr | Tr | Tr | 1 |
| Molasses cane, 1 tablespoon | | | | | | | | | | | | |
| Light | 24 | 50 | | | 13[e] | 33 | 0.9 | | 0.01 | 0.01 | Tr | |
| Blackstrap | 24 | 45 | | | 11[e] | 116 | 2.3 | | 0.02 | 0.04 | 0.3 | |
| Sirup, table blends, 1 tablespoon | 25 | 55 | 0 | 0 | 15 | 9 | 0.8 | 0 | 0 | Tr | Tr | 0 |
| Sugar, 1 tablespoon | | | | | | | | | | | | |
| Granulated, cane or beet | Tr | 50 | 0 | 0 | 12 | | | 0 | 0 | 0 | 0 | 0 |
| Brown | 3 | 50 | 0 | 0 | 13 | 10▲ | 0.4 | 0 | 0 | 0 | 0 | 0 |
| *Miscellaneous* | | | | | | | | | | | | |
| Beverages, carbonated kola type 1 cup | 88 | 105 | | | 28 | | | | | | | |
| Bouillon cubes 1 cube | 5 | 2 | Tr | Tr | 0 | | | | | 0.07 | 1.0 | 0 |
| Chocolate, unsweetened, 1 ounce | 2 | 143 | 2 | 15 | 8 | 28/ | 1.2 | 20 | 0.01 | 0.06 | 0.3 | 0 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gelatin dessert plain ready to-serve, 1 cup | 83 | 155 | 4 | 0 | 36 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Olives, pickled ' mammoth size, 10 olives | | | | | | | | | | | | |
| Green | 75 | 70 | 1 | 7 | 2 | 48 | 0 9 | 160 | Tr | | | |
| Ripe, Mission variety | 72 | 105 | 1 | 12 | 1 | 48 | 0 9 | 40 | Tr | Tr | | |
| Pickles | | | | | | | | | | | | |
| Dill cucumber, 1 large (4 in long) | 93 | 15 | 1 | Tr | 3 | 34 | 1 6 | 420 | Tr | 0 09 | 0 1 | 8 |
| Sweet, cucumber or mixed, 1 pickle (2¾ in long) | 70 | 20 | Tr | Tr | 5 | 3 | 0 3 | 20 | 0 | Tr | Tr | 1 |
| Sherbet*, ½ cup | 68 | 120 | 1 | 0 | 29 | 48 | 0 | 0 | 0 02 | 0 07 | 0 | 0 |
| Vinegar, 1 tablespoon | | 2 | 0 | | 1 | 1 | 0 1 | | | | | |
| White sauce, medium, 1 cup | 73 | 430 | 11 | 33 | 23 | 305 | 0 3 | 1350 | 0 09 | 0 41 | 0 3 | 1 |
| Yeast | | | | | | | | | | | | |
| Compressed, baker s 1 ounce | 71 | 25 | 3 | Tr | 3 | 7 | 1 4 | 0 | 0 13 | 0 59 | 8 0 | 0 |
| Dried brewer s, 1 tablespoon | 7 | 20 | 3 | Tr | 3 | 8 | 1 5 | 0 | 0 78 | 0 44 | 2 9 | 0 |

‡ Iron thiamine riboflavin and niacin are based on the minimum levels of enrichment specified in the standards of identity promulgated under the Food Drug and Cosmetic Act

§ The calcium contributed by chocolate may not be usable because of presence of oxalic acid in that case the value would be 11 mg per ounce

/ Calcium may not be usable because of presence of oxalic acid

ʘ Total sugars only

▲ Calcium is based on dark brown sugar value would be lower for light brown sugar

* Based on 6 8 pounds to the gallon factory packed

# Index